THE 1952 YEAR BOOK *of* GENERAL SURGERY

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PUBLISHER'S NOTE

The dates appearing under the title of this YEAR BOOK indicate that journals received within that period have been reviewed by the editors in selecting the articles abstracted herein

INTRODUCTION

Anyone who is alert to the signs of the times cannot help wondering what is going to happen to the practice of surgery in this country. Is it to be carried out by those who after several years of postgraduate education and training have qualified themselves as specialists, and are so recognized, or is the general practitioner going to resurrect the obsolete title of "physician and surgeon"?

Historically it is of interest that the idea of surgical specialist is new in this country; in fact, it has existed only during the present century. The first surgical society formed here was the American Surgical Association, which was organized in 1882. All of the original members were general practitioners. By contrast, surgical specialization is very old in England, going back to the barber surgeons of the Middle Ages. The charter granted by Henry VIII to the Worshipful Society of Barbers gave them definite professional and social recognition which they lacked previously. There were no barber surgeons in America, probably because since the doctors moved with the settlers into frontier country, it was necessary that each doctor treat all medical and surgical ailments.

Now as everybody knows, there have been created in the United States not only excellent programs of graduate training in surgery but also agencies which after suitable examination and scrutiny of the candidates proclaim to the world that certain ones have fulfilled the rigid requirements of certification or fellowship. I refer, of course, to the various specialty boards in surgery and the American College of Surgeons. The purpose behind all this movement has been only the protection of the public. If a need for such a movement had not seemed desirable or necessary, it would not have occurred.

Within the short period since World War II, however, there has been an increasingly aggressive attempt on the part of some general practitioners to block the development of surgical specialization. Some of these men have stated that about 60% of the surgery of this country is now being done by general practitioners. Perhaps this estimate is high, but a recent unpublished survey in North Carolina shows

that approximately 40% of the surgery in that state is done by the general practitioners.

Can surgical procedures be performed as well by the untrained as by the trained man? The answer to this question should be obvious, yet the more radical general practitioners claim that certain abdominal operations, notably appendectomy and cholecystectomy, can be satisfactorily performed by them But can one always be sure of the diagnosis before opening the abdomen? Is a cholecystectomy always easy? Anyway, why do general practitioners without special training in surgery wish to do it? The hungry doctor, especially when he becomes a surgeon, can be the most dangerous of men. The Golden Rule should not become obsolete If some of the gains accomplished in the setting up of high standards for the surgical specialist are lost by the temporary backward swing of the pendulum, let it be hoped that they will be recaptured.

—Evarts A. Graham

Causes of Death after Operation Comparison between Last Decade and the 1920 s Arthur H. Aufses and Harold Neuhof[1] compared autopsy data for 709 patients dying after operations during 1938-47 with that for a similar series of 800 dying before 1930 Analysis was concerned solely with the causes of death and not with operative mortality They were similar in the two series despite present day reduction in postoperative mortality based on improvement in the art of surgery, scientific supportive therapy and use of sulfonamides and antibiotics There have been a reduction in the deaths due to suppuration, a slight increase in those due to pneumonia and a surprising increase in those due to pulmonary embolism.

Suppuration, whether present at operation or developing postoperatively accounted for 44% of the deaths in the later series as compared with 56% in the earlier series This decrease was probably not due to the use of antibiotic and/or chemotherapy since a decrease also occurred in untreated patients Although such therapy may have prevented many postoperative pulmonary infections, this complication was a commoner cause of death in the later series than in the earlier one There was a concomitant increase in the percentage of deaths from miscellaneous causes however it is surprising that this increase was almost entirely confined to deaths from pulmonary embolism

The percentage of deaths from the original disease was reduced from 42% in the earlier series to 34% in the later series deaths from pneumonia increased from 8 to 11% and deaths from miscellaneous causes from 15 5 to 23% The decrease in deaths from the original disease was almost entirely in the suppuration group Causes of death of patients who received antibiotics and/or chemotherapy and those who did not were remarkably similar Pulmonary embolism was responsible for death in 3% of the earlier group and in 8.2% of the later group despite early recognition and treatment of phlebothrombosis. The percentage of

(1) J Mt. Sinai Hosp. 18:166-178 Sept.-Oct., 1951.

deaths from suppuration developing after gastrointestinal surgery was practically the same in both series, whether or not antibacterial therapy was given. There was, however, a decrease in deaths when suppuration was present at the time of gastrointestinal surgery The greatest reduction in death from suppuration originating after operation was in the genitourinary cases The later series showed a smaller percentage of deaths from suppuration developing after transthoracic surgery when antibacterial therapy was used, but a much higher percentage of deaths from pneumonia

Air Embolism in Operations Done in Sitting Position Report of Five Fatal Cases and One of Rescue by a Simple Maneuver is given by Wallace B Hamby and Richard N Terry[2] (Buffalo) Although the sitting position, particularly in neurosurgery, presents great advantages, experience showed that the patient is predisposed thereby to development of air embolism. Onset is sometimes insidious, with irregular breathing, feeble pulse and low blood pressure, and the condition is unrecognized until autopsy However, more often it is abrupt, with deep inspiration, followed by a coughing exhalation, then a few ineffective breaths succeeded by apnea Blood pressure falls to a low or unrecordable level and the pulse becomes imperceptible While the patient is sitting, heart sounds are inaudible but when he is shifted to the supine position they return with a *to-and fro swishing "millwheel" murmur The recovery of* one patient through postural shift is noteworthy

Woman was operated on for cervical disk protrusion in the sitting position. All due precautions against air embolism were taken, including flooding the field with saline. As the nerve root was being displaced, *the patient suddenly coughed, gasped and ceased breathing* Pulse and blood pressure were imperceptible. The heart beat could not be heard The wound was covered and the chair flattened out. The heart then beat with a rapid, gurgling "millwheel" murmur which, as the patient was turned on the left side, changed to normal heart tones. Blood pressure rose at once to 110 mm. Hg and the pulse became full and regular Normal respirations ensued. The operation was completed with the patient prone. There were no postoperative sequelae.

When a large volume of air reaches the right auricle, a cardiac tampon of foamed blood is produced which is

(2) Surgery 31 212 215 February 1952

difficult to express because it is compressible The right auricle and ventricle become distended, blocking pulmonary circulation, and death ensues. Durant and co-workers found that the air trap is maintained in animals lying on the back or right side but disappears when they are turned on the left side the outflow tract thus becoming inferior to the right ventricle Arterial air embolism may complicate the venous type by passage of air through a patent foramen ovale or other avenues, producing blockage of coronary or cerebral arteries Marbled appearance of the skin, present in two of the five fatal cases, is considered a sign of arterial air embolism.

Minor Surgical Problems of the Newborn. The commonest minor surgical procedure in any pediatric hospital is the cut-down or venotomy according to Willis J Potts[3] (Northwestern Univ)

Technic.—The infant is restrained and the foot and leg are fastened to a board. Sterile operating room technic must be used. The skin over the ankle is prepared and the field draped. A tourniquet is placed around the leg just below the knee. The saphenous vein at the ankle is midway between the anterior surface of the site of the extensor pollicis longus and the medial malleolus. A little local anesthetic is injected at this point and a transverse ½ in. incision made through the skin. The fat and soft tissue are separated by opening a fine hemostat parallel with the course of the saphenous vein The vein is isolated and lifted up with a curved mosquito forceps and tied distally with 4-0 white silk. A piece of silk is placed beneath the vein proximally A cut is made into the vein with a fine sharp-pointed scissors, and a polyethylene tube is inserted in it. The proximal silk suture is tied around the tube in the vein and saline injected. The skin is closed with silk sutures

Exchange transfusions in erythroblastosis can be done in many ways. If treatment is decided on in the first 12-24 hours of life the umbilical artery and vein may be used. A plastic catheter is inserted in the umbilical artery and vein, and with 20 cc syringes the baby's blood is drawn from the umbilical artery and the donor's blood is pumped into the umbilical vein If the transfusion is done after 24 hours of life, a plastic catheter is inserted into the great saphenous vein at the groin and passed into the iliac vein or inferior vena cava The catheter is connected to three way stopcocks, and by means of 20 cc syringes blood

(3) S. Clin. North America 31 1441 1450 October 1951.

is withdrawn with one syringe and substitution blood in jected with the other Blood can be withdrawn from the umbilical artery and injected into the saphenous vein at the ankle

With all methods of exchange transfusion the baby should be kept warm and sterile technic must be used About 5 cc of 10 per cent calcium gluconate should be slowly injected intravenously after 250 cc blood has been given, administration should be repeated at the end of the transfusion, when 500 cc has been given The calcium gluconate will counteract the effect of too much citrate solu tion. A weak heparin solution, about 1,000 units in 150 cc. saline, should be used to wash out the syringes The blood should be warmed to slightly below body temperature The baby should be placed in an oxygen tent or crib after transfusion, and penicillin should be given for a few days An ampule of vitamin K should be given twice daily for two days

All cephalhematomas should be aspirated before exten sive ossification takes place After aspiration, a bandage is placed over the hematoma site and pressure maintained

The commonest birth fracture is that of the humerus It is usually in the midshaft and is spiral or transverse Treatment consists of fixing a few tongue depressors and padding around the arm. If there is radial nerve injury a cock up splint should be placed on the baby's hand Treat ment is not necessary for birth fractures of the clavicle For fracture of the shaft of the femur, simple overhead traction is used with adhesive tape applied to both legs A couple of pounds traction is applied to each leg to just barely raise the baby's buttocks from the bed.

Chest aspiration may be necessary for spontaneous pneu mothorax. Aspiration should never be done without a pre liminary chest x ray If the child has a lung cyst, aspiration should not be done unless it is necessary to relieve dyspnea. Before putting a needle in the chest it must be ascertained that the baby does not have a diaphragmatic hernia with most of its bowels in the chest.

[The warning not to aspirate the chest until after an x-ray film has been made is very important. In many a case the stomach or bowel has been punc tured when they happen to be in the chest. I have even seen such cases mistakenly diagnosed as empyema and drained.—*Ed.*]

Psychologic Mechanisms in Patients with Cancer Harley C Shands, Jacob E Finesinger, Stanley Cobb and Ruth D Abrams[4] (Massachusetts Gen'l Hosp) are convinced that behavior of psychoneurotic patients and those with somatic illnesses differs only in intensity and duration, not in kind

Emotional reactions of cancer patients vary in form and intensity according to heredity, environment and circumstance Usually "cancer" implies untimely but lingering and painful death. The satisfactorily functioning personality is characterized by an integration which permits constant but limited acquisition of new information and elimination of the obsolete The idea, "I have cancer" usually exceeds this limit with disruptive effect on the personality, for we are characteristically oriented toward a future in which death is remote The integrative effort required is often impossible and the patient needs to resort to substitutive and compensatory mechanisms Frequently he is "stunned" becomes speechless his initiative is paralyzed and/or he feels "unreal"—the reaction of depersonalization.

Delay in seeking treatment for cancer is largely attributable to the patient's inability or unwillingness to experience the distress and undertake the work of adequate readjustment to his system of probabilities Without such readjustment, appropriate action to seek treatment is greatly hindered One of the initial tendencies is assignment of responsibility for the lesion to some person when the individual considers himself responsible feelings of guilt (cancer punishment) are prominent when it is someone else, his attitude tends to become paranoid.

It is the physician's role to restrict the patient's distress to tolerable limits. Since illness disrupts former relationships a dependency relationship must be set up between patient and physician Nevertheless dependency increases anxiety an emotion of fear and aggression The aggression may be expressed in irritability and whining desertion of the physician depression or paranoid tendencies Often the physician can lessen these reactions by making a special effort to communicate to the patient clear information in his own language

What the patient should know especially as to progno-

(4) Cancer 4 1159-1170 November 1951

sis, cannot always be easily answered Patients who need time to arrange their affairs may lose the opportunity if they lack adequate information. The prime consideration in deciding how much a patient should know is not the immediate but the eventual reaction Sometimes sublimation takes place and then knowledge of the extent of illness may even make the individual more helpful and kindly, uplifting the morale of others

Patients should be told nothing definite until histologic diagnosis has been established Before this, the diagnostic program should be elaborated In the end, the patient should not be informed of more than he asks to know, if he chooses to evade the issue, even though aware of the diagnosis, *use of the word "cancer" may be avoided The doc*tor should allow the patient to reach a conclusion in his own way, limiting himself to clarification and correction of the patient's own statements.

[This subject ought to be discussed by surgeons more often than it is. Rules of what and how to tell a patient who has cancer cannot be laid down because personalities and conditions differ too greatly In no aspect of the practice of medicine is there greater need of wisdom than in the psychologic handling of the cancer patient. The editor agrees with the authors that the patient should not be informed of more than he asks to know but one of the major difficulties is the decision of what kind of answer to give the wishful and often asked question, "I don t have anything like cancer do I?" It seems to me always bad psychology to lie to the patient because sooner or later he will find out the truth and then lose confidence in the doctor and perhaps in his family also as conspirators in the deceit. Usually he can be informed truthfully in a kindly way if he wants to know—Ed.]

Present Story of Battle Casualties from Korea. Warner F Bowers, Frederick T Merchant and Kenneth H. Judy[5] (M.C., U.S.A.) present information on evacuees from the Far East covering a six months period from Sept 2, 1950 to Feb 28, 1951. Proximity of the Korean incident to World War II resulted in early and effective application of the many lessons already learned. Many experienced physicians were available to apply these lessons. Despite obvious deficiencies and the usual early errors in surgical judgment and experience, the over all understanding of war surgery and the early application of accepted methods of management have resulted in a performance which to date surpasses or equals even the exceptionally fine record *compiled during World War II.*

(5) Surg., Gynec. & Obst. 93 529-542 November 1951

A high percentage of casualties was evacuated to the United States because of a 120 day maximal overseas hospitalization policy Of the 7,039 patients evacuated to the United States, 90.9% came by air

During the period of study an average of 1,000 Army medical officers in the Far East cared for the troops in Korea and Japan. There was 1 medical officer for every 73 hospital patients in Korea and 1 for every 81 in Japan. All precautions have been taken to utilize each medical officer within his specialty or capability Of 26,598 battle casualties treated, only 658 (2.5%) died

A well organized hospital base in Japan was available from the outset of the Korean incident. This was augmented by two convalescent centers sent from the United States Forward hospital facilities have been provided through use of mobile units including surgical field and evacuation hospitals The flow of evacuees from battalion aid stations and other forward divisional units to the various hospitals has been constantly hampered by the Korean terrain. In forward areas evacuation by helicopter has been done unusually often and with outstanding success

The interval from wounding to hospitalization was reduced from 2 9 days in July 1950 to 1 4 days in February 1951, averaging 2 4 days for the entire time About 95% of all casualties received some type of treatment within 24 hours after wounding and 24% some treatment in less than one half hour

Of the 11,638 Army evacuees from Korea 4.4% had some known permanent disability The amputee, hemiparaplegic or paraplegic the blind and the deaf are evacuated in the shortest possible time to specialized treatment centers located within regional areas of the United States so that the patient may have the added benefit of being hospitalized as near home as possible Present policy now requires that these cases be transferred early to Veterans' Administration facilities, often well before complete healing

In general the combat casualties have resulted from small arms fire, hand grenades, mortar shells and artillery There have been fewer wounds from heavy artillery, aerial bombing flame throwers and land mines than seen in World War II. Of the total casualties 65.3% were returned to

duty without evacuation to the United States Of all casualties evacuated to the United States 72.2% were from infantry units

Because of the contaminated nature of wounds in ground troops, the Army medical service advocates delayed closure of wounds Medical officers are instructed to close the deeper structures and to leave unsutured the skin and superficial layers Most secondary closures are done in the overseas hospitals Fracture cases have definitive fixation for sufficient time in the Far East so that stabilization has occurred before evacuation.

Incidence of major burn cases from the war zone has been remarkably low During the period of study only 26 cases were evacuated to the United States. Whole blood transfusions, control of electrolyte balance early excision of third degree eschars to facilitate skin grafting chemotherapeutic agents and the closed method of treatment have decreased the morbidity of burns The exposure method of treatment has been found practical within four to six days after injury but has failed completely when used after that

Incidence of cold injury, frostbite trench foot and immersion foot has been high The Army has conducted extensive research in protective clothing footgear and training doctrine to reduce this incidence The cold injuries are due to the low ambient temperature together with the extremely difficult combat conditions and terrain. A total of 393 cold injury casualties were evacuated to the United States

Ordinary medical disease rate has been the same as in other parts of the Army Chemotherapeutic agents are used when indicated for wounds and are not used locally The over all low mortality and morbidity and high percentage of soldiers returned to duty reflect high credit to all concerned.

[This excellent summary of the casualties in Korea leads one to make a comparison with what goes on in the United States daily with scarcely any notice. The Defense Department's release of August 6, 1952, gives a total of 20,087 battle deaths in American troops in the more than two years of fighting. This number is only a little more than the number of those killed outright by automobiles (18,600) in only the six month period from Jan. 1 to June 30 of this year according to the Safety Council's report. If we were as much interested in the traffic deaths as we seem to be in the Korean casualties we would probably insist that the manufacturers of automobiles would greatly reduce their speed.—Ed.]

Use of Tracheotomy on General Surgical Service Tracheotomy has been found to be lifesaving in a variety of conditions encountered on a general surgical service According to Wesley Furste[6] (Ohio State Univ), it (1) makes possible an adequate airway in any position (2) permits easy removal by suction of secretions blood and aspirated food (3) allows catheter administration of oxygen into the trachea, and (4) facilitates breathing with minimal muscular effort The procedure is so simple that it can be done in a ward bed.

TECHNIC.—One per cent procaine infiltration is used, and the patient's neck is hyperextended. A 4-6 cm. low vertical midline incision is made. The skin subcutaneous tissues and sternohyoid and sternothyroid muscles are spread laterally all veins are divided and ligated and blunt dissection is used about the thyroid gland to avoid hemorrhage. The isthmus of the thyroid is retracted upward. The second, third and, sometimes, the fourth tracheal rings are divided with a knife and scissors and the margins of the trachea elevated. The outer tracheotomy tube with its obturator is inserted, a piece of tracheal ring is punched out if necessary The obturator is then replaced by the inner tube. The subcutaneous tissue is closed loosely about the tube with fine sutures, and the tube is held in place with tape which is tied at the side of the neck.

The inner tube is removed and cleaned often to maintain a patent lumen. The outer tube is changed daily if necessary to keep the local wound in good condition. A suction machine with catheter, the tip of which has been cut off obliquely is kept at the bedside, to remove debris from the patient's airway The tube is usually removed in a week or two after operation but may be left in place for months if necessary If the patient can breathe for 24 hours with the inner tube partially plugged and for the next 24 hours with the tracheotomy tube completely closed, the tube can be safely removed.

Tracheotomy is especially useful for laryngeal edema after suturing of a laryngeal laceration or after ingestion of poison and for incomplete respiratory obstruction, actual or potential. It is also useful when extensive plastic repairs are done on the face and when ensuing edema and accumulating debris after operation on face and neck malignancies may cause obstruction.

Diabetes Mellitus in Surgical Patients is reported by C F Rolland[7] (Univ of Edinburgh) In 300 patients, most of whom were over 55 and many over 70 gangrene of the

(6) Ohio M. J 48 117 120 February, 1952.
(7) Brit. M. J 737 740 Apr 5 1952.

foot was the most common single disorder and cataract the next, 59 patients had infective lesions. Fractures of the femur and neoplastic diseases were common, as they tend to be in elderly patients Of 41 patients not known to have diabetes on hospitalization, only 5 were under 50, whereas 24 were over 60 In two patients recognition of diabetes was delayed until diabetic coma developed after operation. In these 41 patients the diagnosis of diabetes presented no difficulties In most cases there was a history of typical symptoms such as thirst, polyuria, pruritus vulvae or loss of weight, together with the finding of glycosuria and sometimes ketonuria

The diabetes was managed so that the surgeon could treat the patients as if they did not have this disease Most operations were not emergency procedures. Usually, the normal diet was continued until the day before the operation. When patients were taking over 20 units protamine zinc insulin, therapy was rearranged so as to control the diabetes with two or three doses of soluble insulin daily for two days before the operation. When dosage was less than 20 units daily this was continued until the day of operation soluble insulin was then substituted to avoid risk of hypoglycemia, incurred when a patient comes to operation with a large depot of long acting insulin When there was infection, antibiotics were administered during the preoperative days. Soluble insulin was given about 4 hours, and carbohydrate about 3½ hours before operation. The object was to send the patient to the operating room with a reasonably normal carbohydrate metabolism and an adequate store of glycogen in his liver Patients who had been controlled by diet without insulin were given about 12 units of soluble insulin with the preoperative feed. Estimation of the correct preoperative dose for those requiring insulin for everyday treatment may be difficult. The dose was usually one half to two-thirds the usual morning dose of soluble insulin reckoned on the basis of control by two daily doses of this type of insulin. Usually a light fluid diet was given the evening before operation and during the first day bland food containing 1 300-1,400 calories, 150-165 Gm. carbohydrates was divided over five meals From the third day the amount of meat, vegetables and

bread was increased daily until the diet reached normal proportions

Most patients were anesthetized with thiopentone intravenously and the anesthesia was maintained with cyclopropane and oxygen. Curariform drugs were used when relaxation was important A few patients had spinal anesthetics. Results were satisfactory Postoperative vomiting was rare and most patients made rapid and uncomplicated recoveries from the anesthetic General anesthesia of this type is so satisfactory that there is no longer any advantage gained by use of regional anesthesia in diabetics.

The same principles were observed in emergencies as in planned operations Sometimes there was difficulty because of little available information about the previous treatment poor control of diabetes when the need for operation arose caused special problems Under these circumstances, especially if the patient was ketotic, the operation was sometimes delayed a few hours to allow energetic treatment with soluble insulin to effect an improvement in the control of the diabetes In some such cases the insulin was given in part intravenously Large doses of soluble insulin regulated by frequent blood sugar estimations, and intravenous infusions of normal saline were successful in the few cases in which immediate operation was imperative

Diabetic ketosis is often complicated by symptoms suggesting an acute abdominal emergency These symptoms usually subside as the ketosis is corrected. Two young patients had unnecessary laparotomies because of symptoms suggestive of acute appendicitis while they were ketotic. Such a situation may give rise to diagnostic difficulties The patient is often rather un-co-operative and there may be physical signs such as abdominal tenderness and rigidity The presence of a leukocytosis is of no assistance since there is nearly always a high white blood cell count in diabetic coma. The history is of more value than the examination. If thirst polyuria and drowsiness preceded the abdominal symptoms it is likely that ketosis is responsible for the whole picture but when the symptoms appear in the reverse order it is more likely that the ketosis is the result of an acute abdominal emergency

Use of ACTH and Cortisone in Surgery has certain posi

tive indications, according to Hamilton Baxter, Carl Schiller, John H Whiteside and Robert E Randall[8] (Royal Victoria Hosp, Montreal), whereas further investigation is required in other conditions. Patients with frank pituitary adrenocortical failure requiring operation or those with acute or chronic deficiency may be carried through an emergency by adequate therapy

Although these hormones delay wound healing and granulation tissue production in animals, results in man vary Probably large doses are necessary to cause delay of granulation tissue formation in a high percentage of surgical patients Considerable delay of wound healing in some surgical patients may be undesirable whereas in others it is useful. For example, a delay of granulation tissue formation to minimize formation of adhesions about severed tendons and tendon grafts and after operations on the hand may be a valuable adjunct. Clinical studies on the treatment of abdominal adhesions should be carried out The physiologic actions of ACTH and cortisone suggested that these hormones might be useful in severe thermal burns Results, however, have been disappointing in many instances. In view of the high mortality in extensive burns it would seem advisable to continue animal experimentation and carefully supervised studies on selected burn patients

Treatment of hypertrophic scars and keloids and attempts to prolong the life of homologous grafts of skin have not been encouraging

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ARMAMENTARIUM

Value of Hypotensive Drugs in Minimizing Blood Loss in Thoracic Surgery was assessed by Ivor Lewis[9] (Liverpool) The drugs, penta and hexamethonium bromides and iodides, were used in 80 patients.

METHOD —Premedication with morphine and atropine or a similar combination is given. Blood pressure is measured before induction of anesthesia with d-tubocurarine chloride and thiopental sodium Oral intubation is done routinely and anesthesia maintained through

(8) Am. J Surg 83:374 378 March, 1952.
(9) Lancet 2 150-151 July 28 1951

a closed circuit with nitrous oxide and oxygen (1 1), supplemented as required with meperidine hydrochloride, thiopental sodium and d tubocurarine chloride. The patient is placed on the operating table in the jackknife position (feet and head down) and blood drip instituted at no faster a rate than is necessary to replace blood loss. Blood pressure is then measured and a test dose of 20 mg hypotensive drug injected. After three minutes, blood pressure is again measured. If the optimal hypotension of 55-65 mm. Hg systolic has not been reached, another dose (not exceeding 30 mg) is given. Further similar doses may be given every two minutes until the desired hypotension is reached. Then blood pressure remains unaltered for 25-50 minutes. Blood pressure is checked every six to eight minutes until the end of the operation, any rise is countered by further injection until the operation is within 10 minutes of completion. Carotid pulse and capillary circulation are also constantly observed.

As the skin is being sutured, the legs and pelvis are gradually brought up to the horizontal position. This brings the blood pressure up to 80-90 mm. Hg on leaving the operating room. Hypertensive drugs are not required. Then the head-down tilt is slowly corrected. Back in the ward, the patient is put in the sitting position in bed and blood pressure again taken. If it has fallen below the last reading, the foot of the bed is raised. Although the cough reflex has returned, a clear airway must be provided and oxygen must be available.

In 74 of the 80 patients, blood pressure of about 60 mm. Hg was maintained and blood loss was negligible In six patients blood pressure could not be reduced below 90 mm. Hg and oozing was much greater Each of the four drugs was used in 20 patients. Hexamethonium iodide was most effective in reducing blood pressure

Less postoperative vomiting was noted with the hypotensive technic Smaller amounts of anesthesia were required (possibly due to lowered cellular metabolism or lessened nervous reflex irritability) and there was less delay in recovery from anesthesia even after prolonged operation (3½ hours) Dosage depended much more on drug sensitivity than on weight. Maximal amount required for any one patient was 300 mg but, if response is not satisfactory after 150 mg has been given, there is no use in giving any more

Shock seemed to be much less Postoperatively, blood pressure takes three to eight hours to reach its preoperative level. The slow rise allows adequate time for sealing of minute blood vessels. This results in prevention of reac

tionary hemorrhage and excessive postoperative oozing

The hypotensive drugs minimized blood loss and shortened the operation by providing a clear field and by reducing the time taken in hemostasis. In one case the clamp was inadvertently taken off the inferior pulmonary vein before ligation, but there was no sudden gush of blood from the venous stump or difficulty in controlling the hemorrhage

This type of control of the circulation seems to be particularly suitable in thoracic surgery, because the diminution of respiratory movements reduces the venous return to the heart and aids the maintenance of hypotension. Further, the position of the patient that gives the best hypotensive effect is only a modification of the position in common use in thoracic surgery

[Sounds interesting but certainly a much larger experience is necessary before one could consider such a procedure safe.—Ed.]

Fuente Hita Clamp for Deep Ligatures is described by M. Dargent.[2] In one of the teeth of a uterine forceps (although any other forceps may be used) a tunnel is bored, the proximal end at a bevel with the side and the distal one terminating at the very end of the forceps A piece of catgut is introduced in the tunnel with a loop ready for tying the knot, the vessel is clamped The knot is then tied, the two ends of the thread being held parallel to the axis of the forceps so that the knot will slide off the forceps. Only when this has happened and the knot surrounds the vessel right at the forceps tip is strong traction exerted on the ends of the thread, the forceps opened and removed by sliding the proximal end of the thread along the tunnel, and the ligature finished by a second and third knot as usual.

SHOCK

Stress Response in the Severely Burned Interim Report. Everett Idris Evans and W J H. Butterfield[3] (Med College of Virginia) studied the natural stress response to burning injury in 23 patients using careful and extensive

(2) Lyon chir 46:627-628 July, 1951
(3) Ann Surg 134:588-613 October 1951.

eosinophil counts Eosinophil depression appeared to be closely related to the extent of the injury and was almost complete with 40 60% burns A more extensive investigation was undertaken to assess the natural stress response to burning injury and the correlation between the various measurements made, especially between eosinophil counts and corticoid hormone excretions Eosinophil counts, corticoid and 17 ketosteroid excretions and fluid, sodium, potassium and nitrogen balance were estimated daily Results on four burned patients support the hypothesis that the stress response in the severely burned may be largely due to release of a substance from the adrenal cortex with the properties of compound F However, in analyses of individual cases correlations to support this hypothesis were low the correlation of eosinophil counts to corticoid excretions were among the best of the low correlations

The natural stress response of the severely burned was surprisingly large In one patient there was a suggestion that the negative nitrogen balance immediately after burning was related to the level of urinary corticoid excretion.

A syndrome of "burn stress pseudodiabetes," including hyperglycemia and glycosuria but no acetonuria, was seen in some patients In three it appeared early in the course of therapy and resulted in death of two It was probably related to the forced feeding used during the phase of natural stress response after severe burning These findings should serve as a caution to hyperalimentation of burned patients in the phase of natural stress response

Results of this study show that more and similar studies are needed before hormone therapy in the acute phase after burns can be considered on a truly rational basis

Clinical and Experimental Evaluation of Influence of ACTH on Need for Fluid Therapy of the Burned Patient is presented by John W Raker Anne Wight, Albert J D Michel and Oliver Cope[4] (Harvard Med. School) Since a burn causes the damaged capillaries to become abnormally permeable to large amounts of water protein and electrolytes, ACTH treatment has been advocated in the belief that it will restore normal permeability Several methods were used to test this theory (1) Rate of lymph flow from

(4) Ann. Surg. 134 614-616 October 1951.

burned areas and the protein content of lymph were measured in ACTH treated and untreated dogs. No difference was found in the two groups (2) Standard small skin burns were produced in three normal persons and two with Cushing's disease Blister and edema formation was the same in both groups (3) Edema formation was measured by plethysmography in second degree hand and wrist burns in four patients. Two were untreated and two received ACTH promptly No significant difference was noted (4) Burn blister fluid of four patients treated with ACTH was studied Its protein composition was the same as that of fluid of untreated patients. (5) In several burned patients treated with ACTH, intravenous fluid, salt and protein requirements, edema formation and general clinical response were measured. These preliminary trials did not indicate that ACTH had any beneficial effect.

Since no evidence was found that ACTH reverses or prevents abnormal capillary permeability which occurs in skin burns, its clinical use in such injuries is not recommended.

Saline Solution in Treatment of Injuries with Shock D W Richards, Jr.,[5] states that saline given parenterally is essential in treatment of an injured person in shock, being separate from but complemental to use of blood, plasma or plasma substitute The saline is needed to provide salt and water for dehydrated tissue depots and for essential urine volume Its function as an element in the body economy is essentially kinetic, not static, saline solution tends to move through the body rather than remain in it. In dehydration, blood loss and other conditions in which there is a net loss of tissue fluid, additional salt and water is needed for replacement over and above that required for urinary excretion In acute shock, when blood and plasma are not available saline solution rapidly administered intravenously can frequently restore and sustain the circulation for brief periods. One or 2 L. saline solution will maintain a significant increase in plasma volume for 1 or 2 hours, as compared with 12-24 hours when blood or plasma is given.

If the patient can tolerate oral feedings, the saline solu

(5) U.S. Armed Forces M. J 2:1289-1292, September 1951

tion can be given by mouth. It should not be given by mouth when there is vomiting with danger of additional loss of salt and water, when there are vomiting and aspiration with risk of aspiration pneumonia, when there are abdominal injuries and when there is a tendency to pulmonary edema.

Parenteral administration of isotonic saline solution (NaCl, NaCl and dextrose, NaCl and sodium bicarbonate, sodium lactate Ringer and Ringer lactate solutions, etc.) is indicated in the following conditions (1) In dehydration, saline solutions may give complete relief, 1-3 L may be sufficient. (2) In shock due to or associated with massive blood loss, saline is useful to supplement plasma or blood, especially if there is added dehydration, or to sustain the circulation for ½-1 hour while blood or plasma is being obtained. Too much saline intravenously may overhydrate tissues and lead to venous congestion and pulmonary edema. Plasma protein levels will indicate overhydration. (3) In shock due to extensive second and third degree burns, saline solutions up to 3 or 4 L./day may be useful as supplement to blood or plasma in the first 36 hours. Thereafter there is risk of circulatory congestion and pulmonary edema. (4) When enough water and electrolytes cannot be taken by mouth to maintain urinary volume at normal or adequate levels parenterally administered saline solution may be indicated for continuation therapy. Contraindications include congestive heart failure, chest injuries, burns involving the tracheobronchial tree or lungs and renal shutdown, unless actually due to dehydration or existing shock.

Oral administration of saline solution, chilled isotonic or slightly hypotonic salt and sodium bicarbonate or M/6 sodium lactate is indicated in (1) dehydration, when and if tolerated by gastrointestinal tract (2) injuries with mild shock, when 1-3 L. daily relieves thirst and provides fluid and salt (3) mild to moderate burns, when, if parenteral fluids are not available saline solutions, preferably chilled, can be given orally up to 2 to 3 L. daily provided there is no risk of aspiration of vomitus.

Management of Surgical Shock in Poor Risk Patient. W. G. Bigelow, J. F. Ross Fleming and A. G. Gornall[6]

(6) Canad. M. A. J. 65 37-43 July 1951

(Univ of Toronto) state that poor risk surgical patients with a chronic disease, debility and recent weight loss have a deficit in circulating blood volume that may be as great as 50% It appears to be related to the degree of debility and weight loss In 25 cases, linear relationship between blood volume deficit and weight loss showed a 50 cc. blood deficit/lb body weight loss The usual preoperative laboratory studies may show normal serum protein and hemoglobin values in the presence of a severe blood volume deficit Intravascular agglutination of erythrocytes or sludging of the blood has been observed in the capillary bed of the scleral conjunctiva in these chronic disease states.

Among 41 patients who had major operations, 16 without debility or weight loss had a steady blood pressure record during the operation, none received blood transfusions preoperatively The 16 debilitated patients with severe weight loss whose blood volume deficit had been replaced by preoperative blood transfusions showed equally satisfactory blood pressure records, with no significant fall during the operation, whereas 9 with similar debility weight loss and age suffered a serious fall in blood pressure during the operation. Their average preoperative blood transfusion was 250 cc (in none over 500 cc), which was far below their calculated blood volume deficit Two of the nine died in the immediate postoperative period

Since intravascular agglutination is present in debilitated patients this inferred that there is increased rate of destruction of circulating red blood cells by the liver which would account for the reduced red cell mass The agglutinated red cells act as emboli and block many of the capillaries throughout the vascular bed producing a stasis associated with transudation of fluid elements of the blood into the surrounding tissues, increasing the reduction in plasma volume and changes found in the interstitial fluid. The dusky pallor of very debilitated patients is probably due to constriction of the peripheral vascular bed

The blood deficit should be replaced two or three days before surgery 1 000 cc whole blood a day does not have a deleterious effect on these old debilitated patients.

Patients with a blood volume deficit are able to ambulate with normal pulse and blood pressure by virtue of a gen

eralized constriction of the vascular tree Induction of anesthesia alone may paralyze this protective mechanism In the case of a suspected inoperable tumor with adequate blood available, the patient should be transfused with half the deficit volume preoperatively and the blood loss at operation and remaining blood volume deficit replaced during surgery

Value of Blood Volume Determinations in Radical Operations for Cancer of Head and Neck, Including Measurements of Operative Blood Loss Henry P Royster, Henry P Pendergrass, James M Walker and Marie Barnes[7] (Univ of Pennsylvania) studied 45 patients who underwent 54 radical operations on the head and neck 37 had squamous cell carcinoma of the lip or oral cavity and the rest had thyroid carcinoma with cervical node metastasis mucoepidermoid carcinoma of the parotid gland malignant melanoma of the pinna and extensive cystic hygroma Blood volume was determined by the Evans blue dye T 1824 test in 22 patients. Preoperatively 16 patients had blood volume deficits They had no relation to age weight loss or painful mastication or swallowing The greatest deficits were in patients with oral cavity carcinoma who had symptoms over three months Preoperative infusion of blood in patients with deficits was considered helpful in preventing shock.

The operations lasted from 1 hour and 45 minutes to 6 hours Blood loss varied from 800 to 4,000 cc It was usually least during the first hour when the skin flaps were freed and the lower neck contents dissected Major loss occurred during dissection in the suprahyoid, jaw and tongue regions. Large quantities were lost when there were pre-existing infection and radiation reaction Comparison with patients without measurement of operative blood loss showed that no patient with controlled blood balance had hemorrhagic shock, whereas 4 of 10 in the uncontrolled group exhibited shock on the operating table

Pre- and postoperative blood volume tests served as a fairly accurate check on the measured blood balance as determined at operation. The blood volume studies were important in providing information concerning the level

(7) Ann. Surg. 133 830-835 June, 1951

of blood volume in debilitated patients and also as a check on the accuracy of the technic of measuring blood loss at operation, which consisted of weighing all drapes and gauzes used Frequent gravimetric measurement of operative blood loss, combined with the blood volume test, has been adopted as a routine procedure in radical operations on the head and neck to serve as a guide to blood replacement.

Treatment of Shock with Arterenol Norton M. Luger, Allen Kleiman and Rudolph E Fremont[8] (V.A. Hosp., Staten Island, N Y) report a case

Man, 73, was hospitalized because of midepigastric pain. Four days previously he had substernal burning associated with retching, which had been replaced by the pain 24 hours before admission. Both pulse and blood pressure were unobtainable on admission, the skin was cold, clammy and cyanotic, and the abdomen was distended and tympanitic with no audible peristalsis. X rays revealed intraperitoneal air and fluid. White blood cell count was 14,800

Administration of oxygen nasally, 500 cc. whole blood, 500 cc. plasma, 1,000 cc. of 5 per cent dextrose in saline and 250 cc. of 5 per cent dextrose in distilled water failed to alter the patient's condition in three hours. An infusion of arterenol (nor-epinephrine), 2 mg./L., was begun at the rate of 100 drops a minute, two minutes later the pulse was strong and blood pressure was 140/90 Seven minutes after the infusion was started, blood pressure was 170/110, at which time the patient complained of headache. The infusion rate was then slowed to 35 drops a minute and blood pressure fell to 130/80, with relief from headache. Pressure was maintained at this level by variation of the infusion rate for four more hours. At laparotomy 2,000 cc. of serous material was evacuated from the peritoneal cavity, and a perforation on the anterior surface of the lesser curvature of the stomach was closed During operation, 500 cc. whole blood, 500 cc. plasma and 1,000 cc. of 5 per cent dextrose in saline were given On completion of the operation, the arterenol infusion was stopped. Blood pressure promptly fell and was unobtainable for seven minutes, with the pulse becoming weaker When the arterenol infusion was resumed, blood pressure rose promptly Ten hours postoperatively the infusion was stopped and again the blood pressure became unobtainable. The infusion was resumed and continued for 32 hours postoperatively When it was stopped blood pressure fell to 90/60 within four minutes. However it stabilized at this level and then gradually rose to 110/70 Fluid balance was further maintained with plasma, blood, saline and Ringer's solution and recovery ensued.

On the basis of previous criteria, the patient was regarded as having a hopeless prognosis. The dosage of

(8) J. A. M. A. 146 1592 1593 Aug. 25 1951

arterenol was calculated roughly on the basis of 0.2 μg/kg a minute However, for practical purposes the infusion was measured in number of drops a minute, regulation of the rate being guided by blood pressure level The action of arterenol is short lived and therefore its effect can be easily controlled. The patient's pulse rate remained constant between 120 and 130/minute throughout. Its fall to 100 suggested that improvement was taking place, and it was then found safe to discontinue infusion. No symptoms of shock intervened as long as the blood pressure was maintained at normal levels.

It is concluded that arterenol provides vasomotor tone in shock and does not prevent repair of the normal vasomotor mechanisms after shock It is important to diagnose the cause of shock before arterenol therapy is given, lest concealed hemorrhage be aggravated by the drug

Fluid Mechanics and Dynamics of Transfusions Rapid Replacement of Severe Blood Loss D G Melrose and Ralph Shackman[9] (Hammersmith Hosp., London) state that replacement of rapid and severe blood loss, occurring during operations on the heart, large blood vessels and vascular tumors, at rates similar or equal to the rate of loss is necessary to avoid irreversible shock Blood pressure readings during surgery may be misleading as an index of blood loss, especially if the loss is slow and gradual, because the blood pressure can be maintained by compensatory vasoconstriction. If the compensated blood loss is followed subsequently by a brisk hemorrhage during a lengthy operation a sudden and severe hypotension may develop Irreversible shock inevitably follows delay in blood replacement

Both the rate and amount of transfusion should theoretically be of the same order as rate and amount of blood loss, whether the loss be slow or rapid, small or great. Experiments, by direct measurements, variations in flow of blood and saline solution through standard and recognized transfusion equipment, showed that pressure changes, variation in tube diameter differences in length of the cannula and changes in viscosity all affect the flow of blood and saline through transfusion equipment. Avoidance of unnecessary narrowing in the transfusion system minimizes

(9) Lancet 1 1144 1147 May 26 1951.

the resistance and encourages smooth and easy flow Acut bends or kinks in the tubing are to be avoided, and th drip nozzle in the drip chamber should be of the same in ternal diameter as the rubber tubing of the system. Th cannula or needle should slope gently whereas the connect ing tubing should fit over the outside of the needle shank

There are limitations of rapid replacement by standard gravity technics Only 70 ml stored blood can be trans fused intravenously in one minute through a single large Hamilton Bailey cannula if gravity alone is used and height of the reservoir is 4 ft Blood replacement at a rate over 70 cc /minute requires multiple transfusions or some form of pressure delivery *Vascular spasm will cause great dimi* nution in rate of the transfusion if gravity alone is used. A rotary pump and a large Hamilton Bailey cannula allow delivery of 350 ml. blood/minute at 440 mm Hg pressure A simple straight silver cannula 0 063 in. in internal diam eter allows delivery of 350 cc blood/minute at 120 mm Hg pressure

The *risk of overloading the heart by a high speed trans*fusion is not great since even if the rate of transfusion is 350 cc./minute the normal stroke volume of the heart is increased by only 9% and when the stroke volume has become less than normal as a result of hemorrhage the extra amount of blood provided by the transfusion will hardly do more than make up for the acute deficiency Raised jugular venous pressure is evidence of overloading of the circulation and an indication to stop the transfusion The risk of embolism is minimal if a rotary pump is used and hemolysis is not a major complication Local venous thrombosis is a common sequel of pressure transfusion but is not serious In the presence of vasoconstriction only 70% of the estimated blood loss should be rapidly replaced The rest should be given slowly as vasoconstriction de creases

Pressure transfusions were given 12 patients undergoing major surgery Both intravenous and intra arterial routes were used Restoration of blood pressures followed rapid replacement of blood and was achieved without untoward sustained increases of pressure in the right auricle

Experimental Studies with Intra-arterial Transfusion

Edward J Beattie, Jr., James R. Thistlethwaite, Brian Blades and Orlyn Wood[1] (George Washington Univ) gave normal dogs overtransfusions of whole blood via the femoral artery The percentage increase in blood volume and speed of transfusion were found to be major factors in survival. When blood volume was increased about 100% in 30-60 minutes, mortality rate was 30% Animals survived an overtransfusion of 25-35% of their blood volume given in four to five minutes Blood was not given with strict aseptic precautions, but experiments on a small group of animals using strict aseptic technic gave similar results

Experiments were conducted to determine whether speed of transfusion or percentage increase in blood volume produced significantly different effects on respiratory rate, venous pressure, pulse rate or systemic blood pressure With a slow transfusion, respiratory rate rose from 14 to 33/minute, venous pressure rose 7.1 cm. saline, pulse rate fell from 160 to 100/minute and blood pressure was significantly lower than normal. With a moderate speed transfusion, there was no consistent change in respiratory rate, venous pressure rose 8 6 cm. saline, and pulse rate and blood pressure changes were inconsistent. With a fast transfusion, respiratory rate rose from 13 to 24/minute, venous pressure rose 21 cm saline, pulse rate remained normal and blood pressure fell. The changes were more closely related to rate of administration than blood volume increase Venous pressures returned to normal 5-10 minutes after transfusion.

There are two mechanisms of death from overtransfusion. If a transfusion is given rapidly, acute heart failure and death are likely to occur in a few minutes. If it is given slowly and large amounts of blood are used, death occurs from either cardiac failure or cerebral damage from plethora

Intra-arterial Infusion Simplified Technic is described by John E Keet, George O Halsted, Vincent J Collins and Louis M. Rousselot[2] (St Vincent Hosp., New York City)

APPARATUS —Ordinary Baxter or Cutter type blood bottles have been used successfully, most satisfactory receiving apparatus, how

(1) Surgery 31:411-420 March, 1952.
(2) J. A. M. A. 149 418-420 May 31 1952.

that a physician is in constant attendance If sterile equipment is kept available the described apparatus makes intra arterial transfusions possible in any hospital.

Blood Conservation by Autotransfusion Walter R Stager[4] (Univ of Nebraska) notes that a small quantity of blood returned to the patient on the operating table has remarkable recuperative and resuscitative powers. He describes a simple method of collecting blood from the operative site and returning it immediately to the patient intravenously

METHOD—A closed vacuum system incorporating a sterile donor transfusion set into a suction system is used. The apparatus, available in any hospital, includes a Yankauer tonsil suction unit, two gallbladder trocars and a no 13 gauge needle A surgical resident operates the suction in the operative site, where use of hemostats and sponges is restricted, the system functions efficiently without disturbing the surgery Small floating glass balls placed in the collecting flask separate the foam and fibrin that tends to float, and the heavier liquid blood then settles to the bottom and is clot free without anticoagulants. The process produces hemolysis in direct proportion to the amount of suction used. A negative pressure of 4-6 lb. usually breaks down 0 4-0 6 Gm. hemoglobin/100 cc., the lower limits of which have been well tolerated.

In 28 cases, 13,000 cc blood was revascularized from 150 to 1,475 cc /patient. It was done in all types of clean surgical procedures, 15 were for protrusion of intervertebral disks In 24 patients, own blood was transfused with no reactions. The autotransfused blood is highly oxygenated a sample of venous blood in one patient had 16 volumes per cent of oxygen while the surgical field blood had 23 volumes per cent Of four patients receiving donor blood in addition to their own, two had reactions with hematuria and oliguria, and recovered Inadvertently 10-12 lb negative pressure was used for vacuum collecting in these two cases thus returning blood that was unnecessarily hemolyzed to the extent of 1 0 and 1 4 Gm /100 cc

Red Blood Cell Suspension Transfusions are used by Donald W Smith and John Elliott[5] (Miami, Fla.) in about 1 in every 5-10 patients requiring transfusion. One advantage is that they are economical, in that two transfusions (one of red cells and one of plasma) are obtained from a single collection of blood, furthermore, larger doses may

(4) A.M.A. Arch. Surg 63 78-82 July 1951
(5) J A M A 147 737 740 Oct. 20 1951

be given in a single transfusion Another is that they are specific, in that only the required component of the blood is given as indicated Thus, the embarrassed circulation of cardiac or pediatric patients is not overloaded Also they are less allergenic Shock contraindicates cell suspension transfusion (since colloids and not just crystalloids are required to give osmotic pressure to hold fluids in the vascular tree) except when, after restoration of blood volume there is still deficiency in hemoglobin and red cells.

Main indications for red cell suspension transfusions are uncomplicated anemia (iron deficiency), anemia in cardiac disease, hypertension or nephritis, anemia in which rapid effective increase in oxygen carrying capacity of blood is necessary and/or preparation of anemic patients with normal blood volume for surgery Chronic hemorrhage associated with normal blood volume iron deficiency anemia nontoxemic anemia of pregnancy and nutritional anemia require blood cells only The nutritional value of plasma in the last condition is too slight in comparison with what is obtained from parenteral administration of amino acids or oral use of proteins Cardiac patients do not tolerate sudden increases in effective blood volume and therefore the anemia should be corrected by red cell suspension transfusions, which add only to blood viscosity When these patients are on reduced sodium chloride intake there is further reason for using cell suspensions since their sodium chloride content is less than half that of whole blood. In children, except for dehydration from infant diarrhea, severe infection and exsanguination transfusions in erythroblastosis fetalis, cell suspension transfusions are indicated and better tolerated than blood transfusions there being fewer overload reactions. In preparation for elective surgery on patients with normal blood volume hemoglobin and red cell deficiency should be restored by cell suspension transfusions In severe anemia, however the last 1 or 2 units required should be given as whole blood just before or during operation to avoid shock The red cell suspension is prepared as follows

METHOD—Blood is collected in sterile evacuated bottles containing 50 cc of 4% sodium citrate and allowed to stand at 6-10 C for 12 24 hours. It is then centrifuged at 2,000 rpm for 1 hour After

the blood stands another 24 hours in the refrigerator, p[...] removed aseptically into a sterile evacuated bottle and the stopper of the packed red cells bottle closed The cells ar[e used] without dilution for a maximum of five days. They are resu[spended] *with Merck's solution and only on the day of use* (A[...] solution is used rather than acid-citrate-dextrose solution be[cause of] the smaller volume of diluent required and the better qu[ality of] plasma produced) When excessive fluid or sodium chloride [is un]desirable only enough diluent need be used to permit easy [admin]istration

In calculating the red cells needed 8% of the body w[eight is] *considered normal blood volume and 1 lb is considered 500* [...] difference between actual and desired red cell count or hem[oglobin] content is divided by the estimated increase (in the same [units]) from 500 cc to determine the number of donor units (of [...] each) required. For example, a person weighing 100 lb wit[h a red] cell count of 2,000,000 (but desired one of 4,500 000) has [a blood] volume of 4 000 cc and a red cell deficiency of 2,500,000 Eac[h donor] *unit may be expected to increase this by 1/8 of 5 000,000* i.e., 6[...] Therefore, he needs four donor units.

Adjustments in blood volume after whole blood tr[ansfu]sion usually require 24 hours because increased o[smotic] pressure pulls fluid into the vascular tree but it is [more] prompt after cell suspension transfusion since there [is no] such increase in osmotic pressure

Dextran Polysaccharide for Expansion of Plasma [Vol]ume Walter Lyon Bloom[6] (Emory Univ) reports de[...] the administration of a 6% partially hydrolyzed de[xtran] solution to 50 men with a variety of diseases unasso[ciated] with shock. Dextran was given intravenously in 5[...] amounts Neither immediate nor delayed temperatur[e ele]vations were noted, and respiration pulse rate and [blood] pressure remained unaltered during and in the period [after] injection.

Bloom believes that a reaction to dextran need no[t re]sult if the material is properly hydrolyzed fractio[nated] and tested to meet rigid specifications. Renal functio[n, as] indicated by the specific gravity of the urine blood [non]protein nitrogen, phenolsulfonphthalein excretion and [cre]atinine clearance failed to reveal any alteration afte[r in]jection. In 10 patients, bromsulfalein tests, cephalin [floc]culation, icteric index and thymol turbidity showed [no] variation from the predextran injection values. Hemat[...]

values and serum protein values always decreased as a result of hemodilution produced by dextran, and this hemodilution was maintained at least six hours.

The therapeutic efficacy of dextran in clinical conditions associated with decreased blood volume seems assured on the basis of its ability to maintain an expanded blood volume. Obviously it will have great value in civilian defense and military medicine as well as in general practice in peacetime for emergency use and in rural practice where a stable noninjurious, plasma volume expander is needed.

WATER AND ELECTROLYTES

Milliequivalent as Unit of Measure in Calculating Electrolyte Deficiencies in Body Fluids is discussed by O. M. Helmer and K. G. Kohlstaedt[7] (Indianapolis Gen'l Hosp.). Diagnosis and treatment of disturbances in electrolyte and fluid balance are unduly complicated if the physician uses milligrams per cent, volume per cent or grams/100 cc. to express electrolyte concentration. With these units the necessary information regarding the physiologic significance of the various components may not be apparent. The weight of a substance may tell little about its chemical behavior. A system of measurement expressing the chemical equivalence of each component of the body fluid is recommended in management of electrolyte deficiencies.

Equivalence has been ably explained by Newburgh who says: "Imagine these solutions. One gram molecule, that is, the weight in grams corresponding to the molecular weight of NaOH, KOH and HCl have each been dissolved in enough water to make 1 liter. The molecular weights are for NaOH, $Na = 23 + OH = 17 = 40$; for KOH, $K = 39 + OH = 17 = 56$; for HCl, $H = 1 + Cl = 36 = 37$. So the three solutions, each precisely 1 liter in volume will contain, respectively 40 grams of NaOH, 56 grams of KOH and 37 grams of HCl. Solutions containing 1 gram molecule of a substance are called molar solutions and they contain one mole of the substance. When equal volumes, say 1 cc. of

(7) J. Indiana M. A. 45:413-415, May 1952.

the alkaline NaOH solution is mixed with 1 cc of the acid HCl solution, they neutralize each other The same result is obtained when 1 cc of the alkaline KOH solution is mixed with 1 cc of the HCl solution The two alkaline solutions show the same combining power of the same activity for equal volumes Each contains the same number of active particles per unit volume but the weights of the substances per unit volume are not the same Since 1 mole of NaOH exhibits the same combining power as 1 mole of KOH, they are 'equivalent' mole for mole Hence 1 equivalent of any of the three substances is 1 mole of the substance It is evident that the comparison of the two alkalis in terms of their equivalence brings us much closer to what we want to know about their presence in living systems than does the comparison in terms of weight Carrying this conception a step further it is evident that 1 atom of Na is equivalent to 1 atom of K or H That is, 1 equivalent of Na = 23 grams, of K = 39 grams, of H = 1 gram

'Substances react also on the basis of their valence The chemicals mentioned thus far are all univalent. But Ca (atomic weight = 40) is bivalent that is, 1 mole of Ca which is 40 grams, possesses twice the combining power of 1 mole of Na Hence 1 mole of Ca is 2 equivalents of Ca or 40 grams of Ca is equivalent to 2×23 grams of Na and 1 equivalent of Ca weighs 20 grams"

The unit of measure is a milliequivalent, which is 1/1,000 of an equivalent Under normal conditions the extracellular fluid (plasma plus the fluid that surrounds each cell—interstitial fluid) contains approximately 155 mEq /L of cations (base ions which bear a positive electric charge) and an equal number of anions (acid ions which bear a negative charge)

Average concentration of each electrolyte as reported by Gamble is presented in Table 1 All the components except protein are readily diffusible into interstitial fluid so that, with this exception, concentration of these ions in the fluid surrounding the cells is the same as that in the plasma. The table also illustrates the advantages of expressing the concentration of all components in the same unit so that total concentration of cations and anions can be obtained. This is the chief advantage of the system of measurement based

on chemical equivalence It should also be noted that total concentration of cations must always equal that of the anions.

Milligrams/100 cc can be converted to mEq./L. by the following formula

$$\frac{\text{mg./100 cc.} \times 10}{\text{atomic wt.}} \times \text{valence} = \text{mEq./L.}$$

Example 360 mg./100 cc chloride = (360 × 10)/35 × 1 = 103 mEq./L. Factors which simplify this conversion are given in Table 2 Those for converting volume per cent and grams of protein are of special importance

The usefulness of milliequivalents in planning the treatment of electrolyte and fluid imbalance is illustrated by the following examples.

1 *Estimating the amount of solution necessary to return the electrolyte concentration to normal* —If it is assumed that the extracellular fluid volume is 20% or 1/5 the body weight, the following formula is a rough guide for determining the amount of each ion needed for replacement therapy

$$\text{amt. of ion needed (mEq.)} = \frac{\text{patient's wt. in kg.}}{5} \times (\text{normal value of ion [mEq./L.]} - \text{patient's level [mEq./L.]})$$

Example A patient weighing 154 lb is found to have a concentration of 132 mEq./L. of sodium in plasma How much physiologic saline must be given to provide sufficient sodium to restore the concentration in the plasma and interstitial fluid to normal?

To convert pounds to kilograms, divide patient's weight by 2.2 Thus, 154/2.2 = 70 kg Average normal concentration of sodium (Table 1) is 142 mEq./L. and the patient's plasma level for this ion is 132 mEq./L. Substituting in the preceding formula

$$\text{amt. ion needed} = \frac{70}{5}(142 - 132) = 140 \text{ mEq.}$$

Physiologic saline contains 155 mEq of sodium/L. Thus, 140/155 = 0.9 L. or 900 cc physiologic saline to replace deficit

The quantities determined are for replacement of the immediate deficiency and do not provide for losses through kidneys, lungs and skin.

[This excellent article is reproduced here essentially in full because it should be very helpful to many surgeons.—Ed.]

Pre and Postoperative Parenteral Maintenance of Electrolyte Balance with Salt Mixture Containing Sodium, Potassium, Chloride and Phosphate Robert Elman and Theodore E Weichselbaum[8] (St Louis) report observations on 10 patients who had major abdominal surgery (cholecystectomy or resection) No fluids were given orally, and for two or three preoperative and five or six postoperative 24 hour periods 2 L of fluid was given daily with 40 cc. of a salt mixture consisting of sodium chloride 0 05 Gm/cc., dibasic potassium phosphate 0 062 Gm/cc and monobasic potassium phosphate 0 014 Gm./cc

Great variations were observed, especially in potassium excretion. They were not related to severity or duration of operation or to age, sex or weight In a previous study, with intake limited to glucose and water potassium loss on the first postoperative day was considerably greater than could be accounted for by tissue breakdown as measured by nitrogen loss, *but by the fourth day it could all be accounted* for in this manner With the salt mixture, despite the wide variation in individual response the mean potassium balance was slightly positive, except for the first and second postoperative days. Maximal cumulative balances per day in any case were +11.3 and —19.2 mEq With intake limited to glucose and water, there was little or no phosphorus loss in excess of that accounted for by tissue breakdown. With the salt mixture an approximate phosphorus balance was achieved The mean sodium balance was fairly close to zero with maximal cumulative balances daily of +22 and —23 mEq and a tendency for more positive balance (average 10 mEq) on the second to fourth postoperative days, thus suggesting a slight retention of sodium. The mean chloride balance was more negative than the sodium balance, the average cumulative value being —34 mEq probably due to loss of hydrochloric acid in gastric juice Because of this loss of chloride in e s of sodium in sur

(8) Ann. Surg 131:164 172 February 19

gical patients, sodium chloride is preferred to a sodium salt of a metabolizable organic acid

This salt mixture seems to meet the average needs of the body during a pre and postoperative period, with little retention of electrolytes. Any patient who is maintained on parenteral feeding with no electrolyte intake for more than several days may slowly develop an electrolyte deficiency which will prove of clinical significance On the other hand if electrolyte intake is limited to sodium chloride there is always a possibility that some of the sodium may supplant the lost potassium ions within the cell and thus produce an abnormal intracellular electrolyte pattern. This may account for some of the clinical disturbances accompanying potassium deficiency, even when the plasma potassium level is normal. In the presence of anuria potassium must be given cautiously but difficulty arises only if the cells can not take up the cation.

Even with abnormal fluid losses this salt mixture will greatly reduce the likelihood of a severe electrolyte deficiency Potassium deficits, being largely intracellular and cumulative, may develop suddenly and without warning Therapy must be correlated with frequent estimations of the plasma potassium level, which at no time must exceed 5-6 mEq /L Use of amino acids with this salt mixture does not materially change its effects

Observations on Water Intoxication in Surgical Patients Bernard Zimmermann and Owen H. Wangensteen[9] (Univ of Minnesota) report the occurrence of convulsive seizures characterized by dilution of extracellular electrolytes in 17 patients after a variety of surgical procedures Average age was 67 4. In all but one convulsions occurred 12-48 hours after operation Temperature was never extremely high there was no constant change in blood pressure and the syndrome was never accompanied by shock. Seizures usually came on suddenly and in 16 patients were of the grand mal type followed by coma for a few hours to many days Neurologic signs included inequality of pupils, hyper and hyporeflexia and, occasionally plantar signs. In no instance were localizing motor signs observed Serum sodium and chloride concentrations of all patients were greatly

(9) Surgery 31 654-669 May 1952.

decreased Total blood eosinophil counts were low, as would be expected after surgery In most instances strongly positive fluid balance was demonstrable by intake and output data and change in body weight

No conclusions can be reached from the relation of the type of therapy used and the clinical course or final outcome However, in patients handled by prompt administration of NaCl with restriction of total fluid intake, rapid improvement in the blood chemistry picture of dilution resulted Reversal of the electrolyte picture was much slower when this procedure was not used Diuresis also resulted from administration of salt

The physiologic peculiarities of the postoperative patient help explain the mechanisms of water intoxication In the present study electrolyte concentrations remained depressed for four to six days after standard operations, and the Na and Cl dropped to lower levels after extensive than after smaller procedures The relatively dilute state of the extracellular ions in the postsurgical patient is related to expansion of the thiocyanate space From these observations it can be concluded that either the extracellular space becomes larger or anomalies of permeability result in the assumption by these ions of an abnormal position in relation to the fluid boundaries

The phenomena of water retention and dilution which occur in postoperative patients and have their analogues in the "shock phase" of the traumatized experimental animal are not clearly understood Considerable investigation remains to be done on the possible renal endocrine, neural and hemodynamic influences which may mediate this early portion of the response to trauma Intolerance to water and susceptibility to water intoxication during the immediate postsurgical phase are assuredly manifestations of these same phenomena A further quality which water intoxication shares with the deleterious effects of stress is the antagonistic effect on it of adrenal hormones The possibility that a relative inadequacy of adrenal response to operative stress may play a role in the abnormal tendency to hydremia cannot be excluded.

It was concluded that most complications of this nature can be prevented by avoidance of excessive amounts of

glucose solution at the time of surgery and in the days immediately after Daily estimations of body weight and serum electrolyte determinations before actual disturbances develop should make it possible to take measures to prevent this complication Hypertonic saline solution has been of great value in rapidly restoring the normal salt water relation of the extracellular fluid once seizures have occurred.

Changes in Urine and Serum Electrolytes and Plasma Volumes after Major Intrathoracic Operations were studied by Robert K. Finley Jr John Y Templeton III, Robert H. Holland and John H Gibbon, Jr 1 (Jefferson Med. College) in 19 patients Of 13 with carcinoma of the lung 7 had pneumonectomy and in 6 resection proved impossible after extensive dissection. Of three with carcinoma of the esophagus two had esophagectomy and in one the lesion was not resectable One patient had esophagectomy for a lye stricture and in one each a mediastinal tumor and a tuberculoma was removed

Preoperative serum Na concentration was usually low averaging 125 mEq /L Little change was observed after operation The cause of the hyponatremia is not clear All serum K values before and after operation were normal except in two debilitated patients who had received large amounts of potassium low fluids intravenously Serum Cl concentrations were slightly lower than normal and showed no significant difference pre and postoperatively

Before operation urinary Na excretion was 20-240 mEq / 24 hours the day after operation it was always depressed, the range being 1-40 mEq Depression generally lasted about five days and reached the preoperative level in 7 9 days In all cases excretion of sodium was less than that of potassium in the immediate postoperative period Urine K excretion was 10-150 mEq /day before operation and there was no significant change postoperatively Chloride excretion was 12-230 mEq /day before operation and in most cases was diminished the first three postoperative days

Average concentration of electrolytes in the urine followed the excretion levels Potassium however was excreted in greater concentrations after than before operation Urine volume decreased slightly postoperatively therefore the

(1) J Thoracic Surg 219 24 September 1951

total amount of potassium excreted was about the same before and after operation

Total eosinophil counts, made in 11 patients, fell sharply after operation and returned to normal by the 5th day in all but 1 who died on the 11th day The depression of the eosinophil count was most prolonged in patients in poor clinical condition or who had more severe operations. Response of the eosinophil count to ACTH before operation and after the count had returned to normal postoperatively was satisfactory, showing adrenal cortex sufficiency

In six of the 11, the eosinophil count returned to normal much earlier than did Na excretion, in five, the eosinophil count followed Na excretion.

Plasma volume was decreased postoperatively in 11 patients, although blood replacement at operation was adequate Depletion of plasma volume and hemoconcentration was prevented in six others by administration of plasma or gelatin during the first 24 hours after operation.

[It is interesting to know these results but they are about what would be expected.—Ed.]

Occurrence in Surgical Patients of Severe Hypernatremia without Exogenous Dehydration *Bernard Zimmermann and* Esther F Freier[2] (Univ of Minnesota) report five cases in which severe hyperconcentration of electrolytes occurred in the absence of water deprivation and with relatively normal outputs of urine of low specific gravity One patient had ulcerative colitis, one each had been operated on for carcinoma of the face, duodenal ulcer (subtotal gastrectomy) and carcinoma of the rectum and one had postanuric diuresis. Although it is unlikely that any single common factor was implicated in all five they shared some clinical aspects. Pyrexia severe central nervous system depression and in some instances, abnormal neuromuscular activity were present The dire nature of the clinical pictures and the fact that four of the patients died show the necessity for early recognition of hypernatremia

The most reliable chemical index of the condition is elevation of the serum sodium level. The chloride level is also *elevated, and azotemia may or may not be present.* In all instances specific gravity of the urine was low indicating

(2) Surgery 31 373-384 March 1952

some type of failure in the renal response to hyperconcentration of the plasma. Onset of high fever clearly coincided with the appearance of the distorted electrolyte pattern.

Renal impairment, either functional or anatomic, was the immediate cause of the electrolyte distortion. The situation can develop with or without uremia It does not seem unreasonable that any mechanism of renal injury, whether toxic, infectious or circulatory, could result in this type of functional disturbance Deviation of the normal humoral and nervous regulators of renal function must also be considered. Postanuric diuresis, central nervous system lesions and endocrine factors such as those of the adrenal cortex, may be involved.

Prompt recognition of the anomaly and administration of large amounts of fluid without salt should reverse the ymptoms of hyperconcentration of electrolytes. This was pparently accomplished in the one patient who survived.

Replacement of Gastric and Intestinal Fluid Losses in urgery Robert E Cooke and Lawrence G Crowley[3] (Yale Univ) have devised a system of concomitant replacement of abnormal losses from the gastrointestinal tract in surgical patients by the use of gastric and intestinal replacement solutions which are ready made easy to administer and for all practical purposes can be used instead of more expensive time-consuming home made mixtures. Of the three principles of fluid therapy deficit therapy maintenance therapy and concomitant replacement of abnormal losses the two solutions are designed for the latter The solutions are mixed with other fluids that are used for maintenance therapy

The electrolyte composition of the gastric replacement solution is NH_4 (70 mEq /L.) Na (63) K (17) and Cl (150) and is used to replace losses incurred through gastric suction or vomiting Composition of the intestinal replacement solution is Na (138 mEq /L.) K (12) lactate (50) and Cl (100) and is used to replace losses incurred through intestinal suction as well as biliary or pancreatic drainage The solution used is determined by the physician on the basis of the location of the drainage tube and the type of drainage the amount lost is measured every few hours

(3) New England J Med. 246 637-641 Apr 24 1952.

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Hypochloremic alkalosis is often refractory to sodium chloride Persistence of this alkalosis is due to potassium deficiency, which responds to administration of potassium chloride The addition of 3 Gm potassium chloride to 1 L. isotonic sodium chloride is well suited for treatment of hypochloremic alkalosis Potassium must be given cautiously and only under constant supervision to patients with renal insufficiency or dehydration

Etiologic Factors in Postoperative Salt Retention and Its Prevention are analyzed with special reference to potassium by James M Winfield, Charles L. Fox Jr., and Walter L Mercheimer[5] (New York City)

METHOD.—Blood and urine samples were taken 24 or 48 hours before and 12 18 hours after surgery Thereafter daily 24 hour urine samples were collected and analyzed for Na, K and Cl Muscle biopsies were made (1) of the rectus abdominis on skin incision (2) of the rectus femoris or other distal muscles before surgery (3) of the rectus abdominis immediately after operation and (4) postoperatively from other muscles distal to the area of operative trauma. During surgery—after muscle biopsies were made—most patients received 500-1 000 cc blood, 500 cc 0.9% saline and 1 2 L. balanced electrolyte solution (B E.S., contains Na, Cl Ca and Mg in plasma concentrations, and K and bicarbonate precursors in twice the concentration found in normal plasma) On succeeding days 2 3 L. of B E.S was given until fluids could be taken orally usually the fourth day The muscle was dried defatted and analyzed for K and Na.

Urine K increased to an average of 88 (maximum 136) mEq in the first 12 15 hours after surgery It continued at 75 mEq the next day then dropped to normal the next two days and below normal on the fourth or fifth day there after gradually returning to normal. Traumatized muscle in the operative area showed K losses as high as 55% while distal muscle showed little decrease except in one patient (with a 5¼ hour portacaval anastomosis) in whom the decrease was 9% The traumatized muscle also acquired large amounts of Na and Cl which accounts partly for the postoperative salt retention Thus traumatized muscle appears to lose potassium and some of the postoperative urine K may be from this source

(5) Am. Surg. 134 426-440 October 1951

Urinary excretory patterns varied on the basis of extent of surgical procedure, volume of B.E.S. infused and extra renal losses. When fluids were given orally, urine volume and electrolyte excretion dropped extremely low. In no instance did plasma K level fall below 4 mEq., although a slight decrease on the first or second postoperative day was followed by a slight increase.

Apparently a significant part of postoperative K excretion represents that extruded from injured muscles and is roughly proportionate to the degree of local trauma. A small amount of potassium may also have been derived from uninjured traumatized distal muscles. Acquisition of Na, Cl and water by traumatized muscles partly accounts for failure of any Na and Cl to appear in the urine. Another factor is the disproportion between the 1:1 Na:Cl ratio in 0.9% saline as compared with the 14:10 Na:Cl ratio of normal plasma. The total potassium released by traumatized muscles, the total lost by uninjured muscles and the total excreted in urine from endocrine activity await further evaluation.

Although no evidence of B.E.S. toxicity has been found it is questionable whether any potassium should be present in the infusion solution during the first 40 hours after surgery when K excretion is high. Contrarily more than 10 mEq. K in B.E.S. may subsequently be needed when urinary excretion has fallen to a low level. Hypopotassemia did not occur. Postoperative use of B.E.S. resulted in rapid renal excretion of water, Na, and Cl and maintained essentially normal plasma levels of potassium and bicarbonate and the extracellular ions, Na and Cl.

Urinary Chloride Determinations in Estimation of Salt Requirements in Surgical Patients. Wilbur L. Reimers and Robert M. Zollinger[6] (Ohio State University) state that there is a constant threat of salt deficiency during the management of electrolyte problems in surgical patients and that urinary chloride concentrations will reflect a salt deficit before the serum chloride content becomes reduced. Both Fantus and Scribner tests used to determine urine chloride content at the bedside show a high correlation with laborious laboratory methods. Some advise limitation of this determination to the first morning specimen.

(6) A.M.A. Arch. Surg. 63:70-77, July, 1951.

Urinary chloride concentration during and after oral administration of fluids and intravenous infusion of dextrose solutions in surgical patients with normal kidney function may drop below 3 Gm./L., thus giving a false impression of a need for salt. In all cases studied, however, the chloride level of the first morning specimen of urine correctly indicated that salt therapy was not needed, thus verifying the advisability of using the Fantus or Scribner test only on the first morning specimen. Further investigation of patients exhibiting salt lack is needed to determine if salt will appear in the urine in sufficient quantities during saline administration, thereby indicating falsely that replacement is adequate.

Despite certain limitations, there are many surgical situations in which bedside determination of urinary chloride is valuable. In patients presenting problems of salt replacement the first morning voided specimen is tested for its chloride concentration. If the urine contains less than 3 Gm./L., salt deficiency is assumed and a blood sample should be drawn for more accurate determination of the magnitude of salt deficit. Salt replacement may then be started, the total amount to be given being decided after the serum chloride value is reported. If serum chloride content is low, vigorous salt replacement is indicated. If the serum level is unaltered, smaller amounts of saline suffice. If the patient's chloride status must be estimated after he has received fluids orally or intravenously during that day, a serum chloride determination is a more reliable index to therapy.

Diagnosis and Treatment of Hypopotassemia. William A. Steiger[7] (Philadelphia Gen'l Hosp.) states that potassium plays an important role in the operation of many intracellular enzyme systems. Potassium deficits result from lack of intake or from increased elimination of the ion. Potassium intake is reduced after surgery, during starvation, in inanition and alcoholism. Significant losses from the gastrointestinal tract frequently occur with vomiting, diarrhea or Wangensteen suction. Urinary K excretion is increased in salt losing nephritis and by administration of ACTH, cortisone, desoxycorticosterone and sodium salts. Postoperatively patients lose large quantities of potassium in the

(7) Pennsylvania M. J. 54: [illegible] September 1951.

urine even though they are in negative potassium balance

The syndrome of hypopotassemia includes generalized weakness and hypotonia that eventually leads to flaccid muscle paralysis, fall in blood pressure, especially of the diastolic element, clouding of the sensorium, and shallow, rapid respirations due to paralysis of the muscles of respiration The significant ECG change is prolongation of electrical systole as measured by the Q T interval, mainly the result of widening of the base of the T wave

Potassium is most safely given orally Since most foods have high K content, early feeding, even if it be only orange juice, often prevents potassium deficiency A convenient solution is one containing 2 Gm KCl/drachm. Hypodermoclysis is the preferred parenteral route An ECG should be taken after each 6 Gm KCl (77 mEq) is given so that clysis may be discontinued when the Q T interval returns to normal Intravenous administration of potassium is reserved for severe deficiencies and for such severe respiratory depression that an acute emergency exists There is no mathematical formula for calculating dosage When K loss exceeds intake the last store of K to be depleted is that in serum, thus low serum K concentration signifies a deficit in the organism. When potassium is administered orally or subcutaneously serum K content does not rise until the intracellular deficit has been replaced When serum concentration rises the clinical picture improves

Postoperatively the average patient loses 50-100 mEq K (4-8 Gm) daily This amount administered daily will usually prevent deficits Patients with deficiencies require 150-300 mEq K daily until the deficit is replaced This is given until the Q T interval shows persistent return to normal thereafter the daily maintenance dose is 75 mEq

The preferred intravenous solution is isotonic KCl—a 1 14 per cent solution (11 4 Gm KCl/L) containing 154 mEq K/L It is put up in 500 cc quantities in liter bottles so that one bottle contains 77 mEq K (6 Gm.) the usual daily maintenance dose Because isotonic KCl sometimes causes painful venospasm when given intravenously 500 cc saline or glucose is usually added to the 500 cc KCl for patients whose potassium needs are not critical

The chief contraindication to potassium therapy is abnormally high serum K concentration (over 5.3 mEq./L.) Since occasional patients with uremia die of hyperpotassemia from failure of the kidneys to excrete K, azotemia and a poor urinary output are relative contraindications. On the other hand, low blood pressure secondary to hypopotassemia will cause prerenal azotemia, and cautious K therapy will elevate blood pressure, increase urinary excretion and lower blood urea concentration.

The ECG is an excellent guide to prevention of toxicity during K therapy since the toxic effects of hyperpotassemia are almost exclusively cardiac. Tall peaked T waves at serum levels of 5.7 mEq./L. are the earliest evidence of hyperpotassemia and clearly indicate discontinuation of K administration.

Practical Aspects of Potassium Therapy in the Surgical Patient. Edwin H. Ellison, Thomas W. Morgan and Robert M. Zollinger[8] (Ohio State Univ.) state that K therapy is indicated in patients having continued loss of abnormally large quantities of gastrointestinal fluids by vomiting, prolonged gastrointestinal suction, drainage from intestinal fistulas or diarrhea; as prophylaxis for patients about to undergo major abdominal surgery, and in patients with clinical evidence of K deficiency—weakness, aphonia, abdominal distention, increased irritability, ECG evidence of hypopotassemia and low serum K values.

The oral route should be used whenever possible. Daily dose of 9-12 Gm. divided into equal doses of 3 Gm. is usually adequate. A preparation containing 1 Gm. each of potassium citrate, acetate and bicarbonate dissolved in 8 cc. of water can be given orally in a flavored beverage.

Potassium for intravenous administration is prepared in two mixtures. One contains 2.23 Gm. KCl and the other 2.23 Gm. KCl and 6.62 Gm. NaCl. They are weighed out for individual doses and stored in small sterile bottles for use. For infusion, they are dissolved in 20 cc. distilled water and introduced into not less than 1 L. appropriate fluid. Ordinarily KCl alone will maintain normal serum K levels in patients with gastric suction. If intestinal intubation with

(8) Ohio M. J. 47:839-841, September, 1951.

suction has been instituted, 2 or 3 units of KCl may be needed The KCl and NaCl are added to 5 per cent dextrose to form a hypertonic solution that is specifically needed to combat hypochloremia

The only real contraindications to K therapy in depleted patients are severe dehydration and poor renal function. In the presence of dehydration it is important to give 2 or 3 L. fluid for hydration before potassium is added.

Postoperative Potassium Deficit and Metabolic Alkalosis Pathogenic Significance of Operative Trauma and of Potassium and Phosphorus Deprivation. Leonard P Eliel, Olof H. Pearson and Frederick C White[9] (Sloan Kettering Inst.) studied two patients to evaluate relation between low potassium intake and operative trauma in producing the syndrome of apathy, lethargy muscular weakness, abdominal distention and ileus, cardiac arrythmias, and edema The syndrome was noted in patients maintained postoperatively on fluids given parenterally or on a diet low or lacking in potassium and with hypopotassemia, hypochloremia and metabolic alkalosis and ECG changes consistent with potassium deficit Clinical and blood chemical abnormalities in such patients promptly reversed after adequate potassium was given.

One of the patients received no potassium or phosphorus postoperatively The other received optimal amounts of these elements. Both had major surgery for suspected or confirmed neoplasms both were maintained on constant caloric and protein intakes Metabolic changes postoperatively were similar in both, although more pronounced in the one *given no potassium or phosphorus.* Both showed protoplasm loss as evidenced by negative nitrogen potassium and phosphorus balances, intracellular depletion of potassium and phosphorus metabolic alkalosis and hypochloremia eosinopenia and increased urinary excretion of uric acid, creatine, formaldehydogenic steroids and ketosteroids. These changes closely resemble those in hyperadrenocorticism, whether spontaneous or induced by ACTH or cortisone Potassium and phosphorus deprivation preoperatively resulted in intracellular losses of these elements but did not increase nitrogen loss or adrenocortical function. The find

(9) J Clin. Invest. 31 419-432 April, 1952.

ings suggest a post traumatic increase in adrenocortical steroid production, resulting in the metabolic changes observed This is supported by the occurrence of such changes even when substantial and constant intakes of potassium and phosphorus are maintained Similar changes have not been established with respect to nitrogen and the electrolytes post traumatically when hyperadrenocorticism is not noted. However, when adequate potassium ion is provided, diminished losses of nitrogen, potassium, phosphorus and creatine coincide suggesting that potassium deprivation may have been important in these losses

Influence of Potassium on Tissue Protein Synthesis Paul R Cannon, Laurence E Frazier and Randolph H. Hughes[1] (Univ of Chicago) conducted experiments to determine the influence of potassium on tissue protein synthesis as manifested by the ability of protein-depleted rats to regenerate depleted tissues When a repletion ration affording an adequate supply of calories vitamins amino acids and salts was fed these animals they ate well and effectively recovered lost weight Removal of potassium from the salt mixture was followed by poor food consumption failure to gain weight adequately, development of cardiac lesions characteristic of K deficiency and early death. The addition of small amounts of KCl to the deficient ration enabled the animals quickly to achieve effective protein repletion. These experiments demonstrated the quantitative aspects of the daily "need for potassium, in that if the daily intake is below a certain level the animals lose appetite and fail to regain lost weight at a satisfactory rate It has been shown also that K deficiency leads to profound hypotension in rats.

The profound hypotension and death seen in potassium depleted rats are presumably related to the fact that K is essential for activation of certain enzymes, e g., the phosphorylation of creatine for the activation of choline acetylase and for transfer of phosphate from phosphopyruvic to adenylic acid.

Experiments also revealed that two protein hydrolysates of excellent amino acid composition failed to accomplish effective protein repletion in the absence of K in the basal

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(1) Metabolism 1 49 57 January 1952

ration. This result indicates that the K level in these hydrolysates is critically low and that K supplementation is needed when they are to be used in parenteral alimentation. If K is not added in a K-deficient subject the hydrolysates may be unable to manifest the nutritive potentialities of which they are capable.

[These observations on the necessity of potassium in order to accomplish repletion of protein with amino acids are very important. They perhaps explain some of the differences of opinion about the therapeutic effectiveness of hydrolysates containing amino acids.—Ed.]

NUTRITION

New Regimen in Feeding the Critically Ill: Preliminary Report. John Elliott, Donald W. Smith, James J. Griffitts, George T. Lewis and Patrick V. Ferro[2] (Miami, Fla.), as a result of a four year study of the nutritional management of critically ill patients, found that continuous drip feeding solutions containing an excess of amino acids and calories and given by tube into the gastrointestinal tract provide the best means for restoring and maintaining nutrition.

A small semirigid plastic tube with an external diameter of about 3 mm. was devised which could be introduced readily through the nose. It has been well tolerated even when left in place for three months without change. Feeding solutions must be kept sterile so that they can be stored for long periods without deterioration. They must also be clear as precipitates may be confused with contamination. Fluids must be relatively thin and of low viscosity in order to be administered at a constant rate without clogging the tube. Substances which give rise to undesirable gastrointestinal reactions should be eliminated. The formulas must provide daily (1) an excess of amino acids from the protein hydrolysate, (2) carbohydrate not less than 2 parts to 1 part of protein, (3) water, (4) adequate amounts of electrolytes and trace amounts of minerals, (5) 4-6 Gm. sodium chloride and (6) ethyl alcohol. A defatted protein hydrolysate consisting essentially of a mixture of peptones, proteoses and polypeptides with smaller amounts of amino

(2) A.M.A. Arch. Surg. 64: 276-285, March, 1952.

acids than are present in lactalbumin hydrolysates, was well tolerated and is considered the formula of choice when stability is proved. Basic arrangements of formulas with regard to protein, carbohydrate, fluid and electrolytes was adjusted according to the patient's demands. The amount and make up were varied according to whether feeding was the sole dietary intake or a supplement to other food.

This regimen was used for over 500 patients, aged 7 months to 94 years. Solutions were given for 1,214 days (average, 15 days). Adults received an average daily intake of 2,500 cc. formula containing 125-200 Gm. protein and 2,000 calories daily. The regimen restored and maintained the desired nutritional status more effectively than other methods of feeding. The high mortality rate (28%) emphasizes the severity of the illnesses represented in this study.

Parenteral Nutrition with a Solution Containing 1,000 Calories/Liter used routinely after surgery by Carl O. Rice, J. H. Strickler and Paul D. Erwin[3] (Minneapolis) provides full nutritional requirements without overhydrating the patient. The average patient received 2,500 cc. solution, or 2,500 calories. A liter of solution contained 120 Gm. invert sugar (480 calories), 60 Gm. amino acids (240 calories) and 40 Gm. ethanol (280 calories). An ampule of multiple vitamins was added to 1 L. solution once every 24 hours. Sodium, potassium and other electrolytes were added as indicated. No incompatibilities from these additions were encountered.

Continuous administration was through intravenous needle in 28% of patients and through polyethylene or polyvinyl tube threaded into the basilic vein through a 15 gauge needle in the rest. Inadvertent subcutaneous infiltration produced local redness and soreness comparable to that caused by 10% glucose. Some patients had phlebitis and local redness if the polyethylene tube was left in place for over three days. No undesirable systemic reactions resulted.

Nutrition was well maintained. Contrary to common 7-10 lb. weight loss during 10 days of hospitalization these patients gained an average of 2 lb. during an average hospital

(3) A.M.A. Arch. Surg. 64:20-27, January 1952.

stay of 9 days Water balance studies indicated that water retention was not the cause Neither polyuria nor oliguria occurred during infusion With 543 L administered to 109 patients, no harmful effects were seen.

Nitrogen balance studies in 19 patients showed the most favorable results with a solution containing 12% invert sugar, 6% amino acids and 5% ethanol Electrolyte balances are most easily maintained or corrected with adequate simultaneous nutrition. Blood sugar tests during infusions indicated that blood sugar level does not ordinarily exceed renal threshold nor rise as high as with a smaller quantity of glucose

This method of feeding in two instances of biliary fistula suggests its superiority in diminishing bile secretion and allowing the irritated fistulous tract to heal It is also a substitute for gastrostomy and most useful in patients who need mandibular resections for carcinoma

Relation of Protein Nutrition to Healing of Experimental Wounds Martin B Williamson Thomas H McCarthy and Herbert J Fromm[4] (Loyola Univ., Chicago) studied four groups of 24 female albino rats that were wounded on the back. The basal diet given all animals contained for group I 20% casein no gelatin, no methionine for group II, 6% casein, no gelatin, no methionine for group III 6% casein, 11 3% gelatin no methionine for group IV 6% casein, 11 3% gelatin, 0 147% methionine At approximately weekly intervals, eight rats from each group were killed and tensile strength of a 0.5 cm section of the healing wound was determined.

There was a sharp decrease in the amount of nitrogen retained shortly after the animals were wounded, although not all went into negative nitrogen balance Sulfur balance remained positive and essentially constant throughout, regardless of changes in nitrogen balance Within 10 days of wounding, daily nitrogen retention was approximating that before the wound was made

The rate of healing in the animals fed the 6% casein diet was definitely less than that of animals on the 20% casein diet, indicating that healing is more rapid on a high than on a low protein diet Animals fed 6% casein and 11 3%

(4) Proc Soc. Exper Biol. & Med. 77 302 305 June 1951

gelatin did not heal as rapidly as those on the 20% casein diet, indicating that gelatin has a very low biologic value The animals receiving methionine had most rapid healing, indicating that methionine increases efficiency of utilization of dietary or tissue protein, or both Since the methionine fed is probably available to the tissues for protein synthesis as cysteine and cystine as well as methionine, all the sources of dietary sulfur might be considered together as "protein sulfur"

There was no correlation between protein nitrogen intake or retention and the tensile strength or rate of healing in any group There was, however correlation between the amount of "protein sulfur" retained and the rate of healing

It appears that a larger proportion of sulfur to nitrogen is required during healing than for normal tissue synthesis, since (1) after wounding a positive sulfur balance is observed even when there is a negative nitrogen balance (2) increase of the ratio of sulfur to nitrogen by diet, i e., methionine, increases the rate of healing, and (3) healing wound tissue contains more sulfur than the same tissue when it is not wounded.

Use of Invert Sugar Solutions for Parenteral Feeding of Surgical Patients B R Lawton, A. R. Curreri and J W Gales (Univ of Wisconsin) compared the value of invert sugar with that of glucose for parenteral feeding by giving the substances alternately in equal amounts to patients pre and postoperatively Invert sugar is hydrolyzed sucrose, a mixture of equal parts of glucose and fructose With 5% glucose prolonged infusions of huge volumes of fluid are required, and the 10% solution causes diuresis and glycosuria, with resulting loss of essential water and calories

Results indicated that invert sugar while not ideal is a definite improvement over glucose When 1,000 cc of 10% solution was used there was an 86% utilization of invert sugar a 5% improvement over utilization of glucose The greatest differences between glucose and invert sugar were observed in emaciated patients or when 2,000 cc of 10% solution was used In the emaciated patients utilization of invert sugar was 91% and of dextrose only 71% When

(6) A M A. Arch. Surg 63 361 367 October 1951

Some Effects of Intravenous Fat Emulsions on Human Subjects William A Johnson (Cook County Hosp), Smith Freeman and Karl A Meyer[8] (Northwestern Univ) report results in 79 patients given a single intravenous injection of either 10% fat emulsion with 1% cerebrosides or 10% fat emulsion with 1% lecithin fraction Two other fat emulsions were discarded after they produced local reactions. The emulsions used caused some reactions but no serious complications Blood pressure rose an average of 5-10 mm. Hg during injection The pulse rate remained normal except in patients with a febrile response The urine contained no acetone, albumin sugar, blood, fat globules or cells A third of the patients had a temperature rise Anorexia, nausea, vomiting, diarrhea and headache occurred in some patients with a febrile response Lumbosacral pain, a feeling of substernal constriction, and shortness of breath in the first minute or two of infusion were noted in a few patients There was no evidence of kidney or liver impairment.

Daily injections of a 10% fat emulsion (1 Gm fat/kg body weight) for 24 days in two patients produced no evidence of toxicity Daily injections of 20% fat emulsions (3-4 Gm fat/kg body weight) given for 1 11 days to four patients was associated with a decreased platelet count and prolonged bleeding time The thrombocytopenia that developed was probably due to increased intake of fat. Whether this was due to suppression in formation or to increased destruction of thrombocytes is not known

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CHEMOTHERAPY BIOLOGICALS

Clinical Use of Newer Antibiotic Agents in Surgery W A. Altemeier[9] (Univ of Cincinnati) states that bacitracin is effective against many organisms but because of its nephrotoxic factors is used parenterally only for patients without renal disease and with infections from organisms resistant to other antibiotics. It is given intramuscularly in 10 000 unit doses in 2 per cent procaine in physiologic saline every 6 hours for 48-72 hours. If no signs of renal

(8) J Lab. & Clin. Med. 39 176 183 February 1952
(9) J Michigan M. Soc. 50 597-601 June 1951

irritation develop, the dose may be increased to 15 000 30 000 units every six hours Nephrotoxicity appears in about half the patients in three to five days, with urinary albuminuria, granular casts renal epithelial cells and microscopic hematuria The lesion produced is lower nephron nephrosis It usually clears up when bacitracin is discontinued.

Polymyxin B has marked specificity for gram negative bacteria and is bactericidal, not bacteriostatic It is administered intramuscularly every four to eight hours in doses of 2.2 mg /kg body weight to produce antibacterial levels in the circulating blood and lymph. Over half the patients show some toxicity—vertigo headache paresthesia, albuminuria, ataxia or mild microscopic hematuria. A distinct advantage is the infrequency with which resistance is developed by sensitive bacteria

Aureomycin is effective against gram negative and gram positive bacteria and some viruses and rickettsias It is most effective against actively reproducing bacteria and relatively ineffective for adult or resting cultures It is preferably administered orally in doses of 20-75 mg /kg /24 hours average adult dose is 500 mg every 4 hours Aureomycin can be given intravenously (adult dose 100 mg /24 hours) there being a 5 1 ratio in dosage between oral and intravenous routes. Aureomycin glycinate is stable and causes less thrombophlebitis than the leucine solution. About a fourth of the patients have nausea vomiting or diarrhea but toxicity is low

Chloramphenicol is effective in gram negative infections, mixed infections of wounds and the urinary tract due to a wide variety of organisms, in acute pyogenic infections due to gram positive cocci and in gangrene It is best given orally in doses of 50-100 mg /kg body weight/24 hours, average adult dose being 500 mg every 4 hours. The parenteral preparation, containing 25 per cent of the antibiotic in 50 per cent acetyl dimethylamine is given in daily dosage of 20-30 mg /kg Nausea vomiting and diarrhea occur in only a few cases.

Terramycin is effective against gram negative bacteria, other than Bacillus proteus and Pseudomonas aeruginosa against hemolytic Staphylococcus aureus, pneumococci,

streptococci gonococci and Clostridium welchii It is only given orally, adult doses being 500-750 mg every six hours. It is well tolerated by the average patient, only a few having gastrointestinal irritation

Neomycin is effective against Ps aeruginosa and Proteus vulgaris, which are resistant to other antibiotics It is given parenterally, average dose is 500 mg every 12 hours Neomycin has toxic effects on the kidney

Since definite variation in susceptibility to the antibiotics may exist in the same strain it is important to determine by laboratory study *the relative susceptibility of the infecting* bacteria to the various antibiotics in each case One is not justified in using conservative chemotherapy and postponing surgery when surgery combined with antibiotic therapy will produce a more prompt safe and satisfactory result

[These opinions expressed by the new professor and head of the department of surgery at the University of Cincinnati are authoritative because of his expertness as a bacteriologist.—Ed.]

Importance of Laboratory Data in Treatment of Surgical Infections by Antibiotics Frank L Meleney Balbina A Johnson and Paul Teng[1] state that the laboratory is helpful to the clinician with day-to-day problems of surgical infection. The clinician especially the surgeon who usually sees mixed infections cannot treat them properly or intelligently unless he knows which antibiotic or combination will most promptly stop activity of invading micro-organisms. This can only be determined by laboratory procedures directed toward isolation of offending micro-organisms and determination of their susceptibility to all available antibacterial agents and by tests for inactivating substances produced by the organism making all antibiotics impotent

Cultures should be taken at initial examination before *any antibiotics are given Specimens of* blood should be taken for culture if the temperature is 101 F or over Cultures should be incubated both aerobically and anaerobically Surface exudates from wounds or ulcers may be collected on sterile cotton swabs Exudates of body cavities (pleura peritoneum joint space or abscess cavity) may be obtained by aspiration Cultures may be obtained from areas of

(1) J Mt. Sinai Hosp. 18 257 273 January February 1952.

cellulitis by injecting 1 ml. nutrient broth into the center of the area and immediately reaspirating as much of it as possible Ordinarily 0 1-0.2 ml can be recovered. Material on swabs, exudate or fluid should be sent directly to the laboratory and some of the material spread with a Nichrome spatula on the surface of two blood agar plates, one for aerobic and the other for anaerobic cultivation. The rest of the specimen should be planted in a tube of dextrose cooked meat medium. Before incubation a small square or circle of filter paper, each wet with an antibiotic solution, is placed on each plate Penicillin is used in a concentration of 2 units/ml bacitracin, 20 units/ml. terramycin 100 µg/ml. and streptomycin, 250 µg/ml. This disparity in concentration is due to the relative differences in blood agar diffusibility of these four antibiotics It has been generally found that, if micro-organisms are resistant to these concentrations on the blood agar plate no amount of drug systemically administered will control the infection.

More accurate determination of sensitivity may be made, either with the primary culture or later, with pure cultures of each micro-organism recovered by using varying concentrations of each antibiotic on a plate by itself One half of 1 ml. of a young broth culture is deposited and spread evenly over the surface of a blood agar plate with a Nichrome spatula The surface is allowed to dry in the incubator and a series of five or six penicylinders are applied to the surface the antibiotic in varying concentrations is delivered to the penicylinders. The concentrations with penicillin may run 10 5 2 5 1 25 0 65 and 0 3 units/ml. with bacitracin 50 25 5 2, 1 0 5 units/ml. with streptomycin, 250 125 25 10 5 1 µg/ml. with terramycin, 200 100 50 25 5 µg/ml. Inhibition can be still more accurately determined with pure cultures in a series of test tubes This is necessary with aureomycin and chloramphenicol because of their rapid deterioration in solution. Most reliable is a five hour turbidimetric test

If the culture is susceptible to only one of these drugs that is the drug for treatment If it is susceptible to two or more one or a combination may be selected for treatment If the micro-organism is resistant on the plate to all of these antibiotics, inhibiting concentrations for each may be

determined by dilutions ranging from 100 units/ml. downward in fluid mediums. Frequently synergy between two or more antibiotics may be demonstrated, whereby fractions of minimal inhibiting concentrations will in combination inhibit the growth of the micro-organisms.

The laboratory director should be given necessary details of clinical history to suggest causative agents. At times, use of special mediums may be necessary

Terramycin and Aureomycin in Surgical Infections Edwin J Pulaski, Curtis P Artz and Eric Reiss[2] (Brooke Army Hosp, Fort Sam Houston, Texas) report results in 47 patients with surgical infections treated with aureomycin and 153 treated with terramycin. These drugs were found superior to penicillin because of their wider antimicrobial spectra and convenient oral administration without allergy or drug fastness. Most of the 200 infections were caused by *pyogenic cocci Dosage was 3 Gm initially followed by 0.5* Gm every six hours There was evidence that this dose gave effective blood levels of the antibiotic

Results were satisfactory in 35 of the 47 infections, mostly cellulitis, with or without abscess, treated with aureomycin. There were untoward reactions in nine patients, vomiting in two, urticaria in one, nausea in four and bulky stools in two

There were no failures in 41 cases of cellulitis treated with terramycin, although 5 patients had such severe infections that intravenous medication was required In 13 cases of cellulitis with abscess some surgical measure was also performed. Of six patients with bacteremia results were excellent in four given terramycin and one aureomycin intravenously Terramycin therapy was unsuccessful in the sixth patient.

Results were excellent in two and good in two patients with gas gangrene of the leg after amputation and terramycin therapy This drug also gave excellent results in three patients with anaerobic clostridial cellulitis, two with actinomycosis, two with furunculosis one with a human bite infection, and two with carbuncles and the results were good in two and excellent in one with acute osteomyelitis

In 16 patients with infected traumatic wounds results were

(2) J A M A 149 38-40 May 3 1952

excellent in 4, good in 9 and doubtful in 3 Terramycin did not help 10 patients with infected burn granulations

Terramycin was used in 56 cases of acute secondary peritonitis caused in some by appendicitis or penetrating gunshot wounds of the abdomen. Results were excellent or good in 23 of 27 patients with spreading peritonitis in 13 with localized peritonitis secondary to appendicitis, and in 3 of 10 with localized peritonitis treated by surgical drainage and terramycin. Results in 52 of the 56 cases were successful the 4 failures were attributed to organisms resistant in vitro to terramycin.

Many good results were achieved by a combination of antibiotics and surgical drainage Both aureomycin and terramycin are good adjuvants to surgery

Clinical Experience with Streptokinase and Streptodornase in Tuberculosis is presented by Joseph M Miller, errin H Long and Edward S Stafford[3] (Johns Hopkins niv) These enzymes do only two things when placed near e area of infection. Streptokinase causes liquefaction of ibrin, and streptodornase causes hydrolysis of desoxyribose nucleoprotein and desoxyribose nucleic acid. Although the healing of infected wounds is enhanced by removal of these substances, the need for the usual surgical procedures is not eliminated. Since these compounds have a surface action only results are best when exteriorization is as complete as possible If this is not possible drainage should be adequate The surface action is a relative disadvantage in bone infections, where penetration of the dense matrix is poor Use of the compounds is still indicated, but care must be exercised to place the enzymes in the area of infection and duration of treatment is longer Adequate circulation to the local area is necessary The blood supply may be improved by use of heat, elevation, sympathetic blocks or sympathectomy Necrotic tissue which prevents contact with the constituents to be hydrolyzed, must be removed Sloughing tissue may contain trypsin which inactivates streptokinase Slough is an excellent culture medium for bacteria, and dead tissue prevents proper contact of antibiotics with bacteria that may be buried in the slough and inhibits normal reparative processes Badly infected lesions may be treated

(3) J A M A 148 1488-1489 Apr 6 1952.

every four hours, whereas in less severe cases only one daily application may be required.

Many surgeons are unwilling to drain tuberculous abscesses for fear of secondary infection Results obtained thus far indicate that such fear is not justified Removal of thick purulent material from the cavity walls by enzymes allows more effective antibiotic action. Nineteen tuberculous infections, 14 severe, were treated by these methods Four patients had tuberculous empyema, 5 tuberculous lymphadenitis and 10 tuberculosis of the bones, joints or tendons. In 16, the infection was controlled and all wounds and sinuses were healed The other three patients had advanced, progressive tuberculosis Local improvement was obtained in each but systemic progress continued with fatal result

In empyema the enzymes rapidly convert thick pus into thin material, which is readily aspirated or drained With aspiration or drainage they prepare the empyema cavity for successful thoracoplasty The thick visceral pleura well organized and relatively avascular does not lend itself to chemical solution Since pus is made thin spread of the infection may easily occur in the presence of a bronchopleural fistula This complication was not seen in two instances, but when a fistula is present enzyme therapy must be undertaken with caution and followed as rapidly as possible by surgical collapse if there is an unyielding roof of bone Experience in two instances demonstrated that fibrinous adhesions may be dissolved but that lysis of organized adhesions or adhesions containing collagen will not result

[Our own experience with these enzymes at the Barnes Hospital, although limited has been favorable —Ed.]

WOUNDS WOUND INFECTION AND BURNS

Management of Common Superficial Wounds Champ Lyons and Samuel E Upchurch[4] (Med College of Alabama) use the term superficial wounds to designate injuries confined to the skin, subcutaneous tissue and fascia, when muscle damage is minimal wound shock or complex injury is not present and the patient can be treated on an ambula

(4) S. Clin. North America 31 1271 1281 October 1951

tory basis All open wounds should be considered contaminated Foreign substances in the wound and the time since injury determine the degree of contamination. A closed wound, however, contains devitalized tissue, which is a favorable pabulum for the growth of bacteria A period of six hours from the time of wounding has become traditionally acceptable as a period of minimal contamination unlikely to be associated with hazard from primary closure Since any open wound is vulnerable to tetanus infection, the patient should receive a booster dose of tetanus toxoid or prophylactic antitoxin.

It is necessary to differentiate clinically wound contamination suppuration and infection. Suppuration is usually due solely to bacterial decomposition of devitalized tissue and can be treated by adequate cleansing and débridement Wound infection implies that bacteria usually hemolytic streptococci, have invaded living tissue and jeopardized the viability of previously sound tissues. Associated conditions are cellulitis, erythema lymphangitis swollen and tender lymph nodes and systemic signs of infection. Wound infection in association with wound suppuration may be due to either hemolytic streptococci and/or anaerobic bacilli.

Prophylaxis of wound suppuration consists of meticulous irrigation with saline Soaps, detergents and germicides may be applied up to the wound margin but should not contaminate the open wound Bleeding vessels should be tied with silk or cotton 4 0 ties and foreign bodies and loose tags of tissue should be removed If the wound is soiled with irremovable debris it should be excised in toto The wound should be closed at the time of débridement by suture or grafting and should be protected by pressure dressings and wound splints Because it is streptococcidal penicillin is the best drug for prophylaxis of wound infection.

Proper treatment of a simple suppurative wound includes irrigation and excision of residual devitalized tissue The wound is dressed with fine mesh gauze and splinted with a pressure dressing After three to five days of penicillin therapy it is re-examined and, if clean should be closed by secondary suture or skin grafting

If there is an established wound infection the appropriate antibiotic as determined by sensitivity tests should be given

and warm moist packs placed on the wound. Surgical débridement may be done five to seven days after antibiotic therapy has been started It requires about three days for wound edema to disappear completely and about five days for lymphadenopathy to regress The wound is inspected three to five days after débridement and closure performed without tension and without freeing the edges of the skin. Skin grafting will be indicated in a larger number of wounds managed in this category Three to six months after healing, a previously infected wound may be revised for improved appearance or greater usefulness or durability

Deterrents to wound healing such as vascular insufficiency, venous congestion and lymphedema can be prevented by loose suturing and dressings and elevation of the injured extremity

Because of the rich blood supply in the face, wounds in this area can be closed up to 24 hours after injury Only fine suture material should be used. Avulsed wounds should be closed with planning for future plastic surgery If there is a large defect it is best to suture mucous membrane to skin around the circumference of the defect. The oral mucosa should be closed loosely to allow oral wound drainage Wounds more than 24 hours old should be left open and treated as simple suppurative wounds

Through and through ear lacerations may be closed by a fine closely spaced row of 5-0 silk sutures in the anterior and posterior skin Similar lacerations of the eyelid may be closed by a single layer of closely spaced mattress sutures of 5-0 silk placed carefully through skin, subcutaneous tissue, muscle and tarsal plate but not through the tarsal conjunctiva Ophthalmic ointment is placed in the conjunctival sac and a pressure dressing applied.

The edema associated with severe contusions of the hand must be reduced with pressure dressings and stellate blocks in order not to impair function. All tendon and nerve injuries should be repaired immediately if the wound is clean and has not been present for over six hours. Total skin loss with exposed tendon should be repaired with a sliding or pedicle graft An immediate pedicle graft will save the distal interphalangeal joint in guillotine amputations through the distal phalanx

Biology and Pathology of Granulation Tissue in Reparative Surgery Bensión Goldenberg[5] (Buenos Aires) points out some general considerations closely related to the processes of repair This process has no predetermined end. A direct cause and effect relation exists, but it cannot be precisely defined. There are, however, elemental properties in the protoplasmic substance irritability, motility, adaptation, adaptability and elasticity, and maturity Cellular differentiation is inversely related to the capacity of proliferation and morphogenesis A direct relation exists between function and form. Repair takes place in connective tissue and inflammation and restoration have periods in common Connective tissue is restored by connective tissue, whereas epithelial tissue regenerates from epithelium. Growth capacity of granulation tissue is infinite but that of epidermal tissue is limited. Nature heals wounds spontaneously and the constitution and natural condition play an important role in the quality of repair The fate of the scar tissue cannot be foreseen.

Whatever the injury and however large it is a dissimilative process followed by an assimilative one is always observed. In the analysis of repair, every diagnostic datum has its histopathologic equivalent and every clinical manifestation or humoral repercussion its physiopathogenic equivalent. In the dissimilative phase four layers can be differentiated from the center toward the periphery coagulated fibrin layer liquid or proteolytic, layer layer of serous imbibition and cellular liberation, and layer or hyperemia and diapedesis of leukocytes Three processes dominate the assimilative phase fibrogenesis epidermization and formation of new vessels.

Granulation tissue has two great functions it provokes sterilization of the wound and orients cicatrization It is defense tissue which is infected or simply infiltrated. Its growth is unlimited and checked only by the epithelial covering when this is produced on the surface From a clinical viewpoint granulation tissue is in good condition when it is recent with dark red small, well vascularized grains and little exudate is hard or firm to the touch and is distributed in a homogeneous layer When loss of substance

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(5) Plast. & Reconstruct Surg. 8 9 (3 July 1951

does not culminate in a scar while healing, or if healing occurs slowly, a raw surface is said to have formed. Factors influencing raw surface granulation are the dimensions of the *loss of substance, overlapping of the epidermal level* by the exuberant granulation, mechanical causes, natural conditions and constitutional factors, vascular factors, neurotrophic factors humoral factors such as glycemia lack of ascorbic acid and hypoproteinemia and infections Granulation tissue forms granulomas when there are foreign bodies in the wound

In the repair of any wound the damage, systemic conditions and tissue reaction must be considered. Any artificial agent, physical or chemical, used to stimulate epidermization is harmful The best therapeutic agent is normal saline solution Granulation tissue should not be eliminated or curetted in the course of dressing It has not been proved *that cancer is more frequent in granulations than in scars,* but it is interesting to note that there is a continuous "epithelial irritation" on the border of the granulation and epidermis Careful technic and use of the smallest possible amount of suture material will prevent granulomas.

[Some day a hormone or growth-stimulating substance will be available which will hasten the healing of wounds.—Ed.]

Granulation Tissue Geoffrey Hadfield[6] states that the function of granulation tissue, the immature and highly fertile mesenchyme is to invade and replace dead, dying, degenerate, ill nourished, time-expired and useless tissue in any location in the body and in a multitude of pathologic conditions The newly formed, active proliferating capillary blood vessels of granulation tissue are primarily responsible for its capacity to invade Large numbers of proliferating mesenchymal cells follow in the wake of the capillary front. Inflammation and ischemia will retard or prevent growth of granulation tissue Liquefaction of tissue and phagocytosis of the dead material by histiocytes favor vascularization.

Capillary penetration of the fracture hematoma in cortisone-treated animals was reduced to an insignificant degree, and as a direct consequence bone formation was greatly inhibited In study of the effects of cortisone on epiphyseal endochondral bone growth, capillary penetration of the

(6) Ann. Roy Coll. Surgeons England 9 397-407 December 1951

zones of calcified cartilage, a time-expired and useless tissue, was almost completely arrested and formation of cancellous bone behind them seriously inhibited. In young rabbits there was striking reduction of thickness of the cartilaginous epiphyseal plate and metaphysis

Normal pre and postnatal development and growth of the skeleton are therefore determined by a cellular mechanism identical with or closely allied to formation of the granulation tissue of disease. Normal bone growth is under the control of pituitary somatotrophin, and administration of this hormone to young animals causes a spectacular increase in thickness of the metaphyseal zone of penetrating capillaries and in bone growth. This effect is inhibited by cortisone. Somatotrophin and cortisone are probably mutually antagonistic and part of a balanced physiologic mechanism. Somatotrophin probably controls the first phase of mesenchymatous replacement, that of capillary vascularization and cell multiplication. The second phase which occurs after there have been sufficient vascularization and placement of immature mesenchymal cells is one of capillary devascularization and differentiation of immature cells. Cortisone inhibits primarily vascularization, but full differentiation depends on ascorbic acid also

[This is important and fascinating work. More study of the fundamental processes involved in the growth of tissues will undoubtedly lead to "practical" discoveries which will shorten the period of healing a wound, whether bone or soft tissue. It seems curious that now for the most part, we are content with the old adage, "let nature take its course."—Ed.]

Physical Basis of Scar Contraction was studied experimentally by David Min Chyang Ju[7] (Columbia Univ.) Elastic membrane was placed under varying tension by gluing different thicknesses of rubber band on it which were under tension in different directions The rubber band was considered the equivalent of a scar and the elastic membrane of the skin.

Five experiments were conducted, with the following five deductions (1) The membrane at either end of a contracting band is stretched producing triangles of transmitted contraction (T C triangles) and the membrane above and below the long axis of the band is relaxed and thrown into folds (2) The stronger or thicker of two contracting bands

(7) Plast. & Reconstruct. Surg. 343-363 May 1951

has greater influence on the surrounding structures (3) The greater the tension of the membrane, the less the contraction of the contracting band, and the less its effects of transmitted contraction on the surrounding structures (4) A membrane fixed to a deep structure along one lateral column but free at another transmits greater contraction of the incorporated elastic band at the free end than at the fixed (5) When two contracting bands intersect each other in a V form there is a combination of T C triangles at the intersecting end and the direction of resultant contraction is in between the bands, from the tip of the V toward the base

Histologically most longitudinal fibers of the skin are arranged in the direction parallel to Langer's lines, there being only a few short fibers running between them in the form of a network. Therefore the skin is comparable to a membrane which is under greater *tension* in one *direction* than the other A hole in the skin assumes an elliptic shape with the axis parallel to Langer's lines Any incision made parallel to Langer's lines therefore lies along a line of higher tension than one perpendicular to it Deduction 3 has its clinical application in that the difference in equilibrium of forces and that in the degree of active contraction of the scar under varying tensions explain why scars parallel to and scars perpendicular to Langer's lines behave differently Furthermore, the direction of muscle pull beneath the skin is perpendicular to the skin tension lines. Thus the contracting muscles do not have to pull against the tension of the skin and the skin can maintain its tension during muscular activity The relation between muscle activity and skin tension is like that between the longitudinal motion of an accordion and the accordion plait A scar parallel to Langer's lines is comparable to the transverse frames on the plait which do not alter their size or tension whereas a scar perpendicular to Langer's lines is subjected to constant stress and pull like the longitudinal motion of an accordion, and such a scar thickens.

Similarly a scar across a joint is constantly subjected to stress and pull during muscular activity This causes trauma microscopic hemorrhages, subclinical inflammation and eventually fibrosis and thickening of the scar As mus

cle pull is increased in an endeavor to stretch the scar, greater thickening results, this continues as a vicious circle

Points along a line parallel to the joint surfaces are designated static points, whereas points along a line perpendicular to the joint surfaces and in its principal axis of motion are designated dynamic points. The relative change in the dynamic points can be expressed in terms of percentage change or dynamicity, and each joint has its characteristic dynamicity flexor surface of shoulder, 175%, flexor surface of neck, 121%, flexor surface of inguinal region, 115% flexor surface of elbow, 111% flexor surface of knee, 107%, flexor surface of finger, 106% These are the joint skin surfaces with a dynamicity of over 100% and they are the most frequently involved areas of cicatricial contractures.

The deductions were applied to Z-plasty and its mechanism in releasing contractures, which is not only by lengthening the scar band but, more importantly, by changing the direction of the scar tissues so that they are spared the stress and pull of muscular action. A Z incision is a combination of two V incisions, as in deduction 5, and the zigzag incision is composed of a series of V incisions The contracting force in the zigzag incision is a summation of the small contracting forces in the V flaps. Thus, clinically, the chordee resulting from a straight longitudinal incision on the ventral surface of the penis is seldom seen after a multiple Z incision.

The trap door effect of a U shaped scar can be explained by dividing it into three arcs each subtended by a chord. The chords represent convergence of T C triangles inside the semicircle and divergence of them outside it. The convergence produces a preponderance of transmitted contraction effects inside the semicircle

A circular scar on an extremity even though placed along Langer's lines causes disability from constriction of the circulation. In addition, since it is a continuous ring with no intervening skin to offer any counteracting force the contracting and constricting force is exerted regardless of the relation of the scar to Langer's lines. In addition, the ring acts as a combination of two semicircles to produce a double trap door effect. This situation is not relieved by excision of the scar (which merely replaces the circular

scar with another one) but is benefited by a Z plasty (which changes the direction of pull)

Fixation of one end of a scar with the other one free as in deduction 4, explains the notching at the vermilion border of the upper lip after harelip repair and the deforming ectropion of the eyelid after a similar repair of that structure

Permanent Pedicle Blood Carrying Flaps for Repairing Defects in Avascular Areas James Barrett Brown Minot P Fryer and Frank McDowell[8] (Washington Univ) state that in repairing a defect in an area of diminished blood supply a permanent source of blood supply is made available if the pedicle of the flap can be arranged so that it does not have to be cut later With this permanent pedicle blood and nerve-carrying flap the repair may be more certain and its permanence best assured The procedure is applicable when there is sufficient tissue adjacent to the defect, such as in radiation lesions in defects extending into bony cavities such as about the tibia and foot, when bone may have to be replaced such as about the jaw about the chest and axilla and in densely scarred areas resulting from gunshot wounds or traffic accidents in extensive war injuries in defects of the scalp with or without bone loss in defects following tumor removal when bone is exposed, as over the vertebral spines pelvis and elbow and in decubitus ulcers

The procedure is useful for severe painful radiation lesions of the axilla that follow postoperative treatment for breast carcinoma A large permanent blood-carrying pedicle flap from the flank is carried into place in a single operation The donor site is repaired with split grafts at the same time The shift is that of a huge direct rotated flap which supplies blood and nerves and protects the under lying vessels, nerves and muscles If necessary for exten sive repairs, the flap can be delayed in several stages delayed permanent pedicle flap can approach the wound from two sides

The permanent pedicle blood-carrying flap gives the best repair in deep holes of the tibia especially if the hole is just under the tibial plateau and there is a question of ad

(8) Ann. Surg 134 486-494 September 1951

equate support for the knee joint It is important that bone necrosis be checked. There may be great benefit from the healing that closure with a free graft may give so that the area is in the best possible condition for reception of the pedicle

Severe jaw injuries such as gunshot wounds, that require bone grafting, and also a bed and covering for the graft respond best to this procedure The flap is usually available lower down on the neck and is moved up on two pedicles left permanently attached The foot on both plantar and

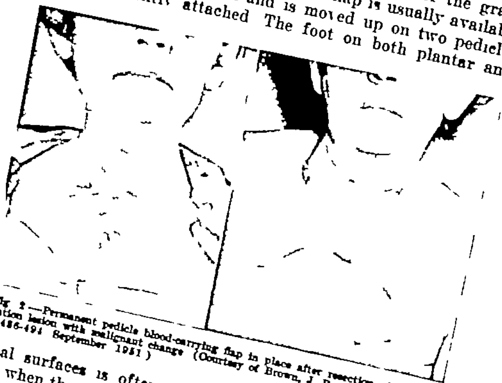


Fig 2—Permanent pedicle blood-carrying flap in place after resection of extensive radiation lesion with malignant change (Courtesy of Brown, J B., *et al*, Ann. Surg. 134 486-494 September 1951)

dorsal surfaces is often repaired with permanent pedicle flaps when there is deep dense scarring over relatively small areas but of such a nature as to be painfully crippling as is seen in gunshot wounds warts radiation lesions and traffic injuries.

Decubitus ulcers are often repaired in this manner If the flaps can be designed and carried into place without tension, the best repairs can be expected. It is futile to pull or ad vance flaps into place by pulling lateral flaps together after extensive undermining This often results in loss of flaps and more scar, so that a final flap is difficult to obtain In the neck the flap is available from the chest and is indicated

in deep losses, as from radiation effect and radical tumor removal Replacement all the way to the trachea has been made after radical resection for malignant radiation lesions as a lifesaving procedure (Fig 2)

Effect of Locally Applied Cortisone Acetate on Survival of Skin Homografts in Rabbits R E Billingham P L Krohn and P B Medawar[9] *(Univ of Birmingham) found* that skin homografts transplanted in a stated fixed dosage between rabbits of high genetic diversity survived six to nine days. Local application of 5 mg cortisone to such homografts every third day at least doubled survival time The dosage of cortisone that was effective when applied locally was ineffective when administered systemically Local administration of 5 mg every third day was somewhat less effective than systemic administration of 10 mg every day It is likely that local application of smaller quantities at more frequent intervals would have been more effective *it is also possible that cortisone can be better applied than* as crystals suspended in a watery base Local application of cortisone to homografts was almost wholly ineffective when the grafts were transplanted to a rabbit preimmunized by an earlier grafting of skin from the same donor or concomitantly immunized by untreated homografts transplanted on the same occasion.

Cortisone acts principally by retarding development of immunity to homografts rather than by preventing its local fulfilment in the grafts Cortisone does, however prevent the local expression of the immune state in a slight but discernible degree

The slight prolongation of the life of homografts on concomitantly immunized or preimmunized animals might be due to an antihistamine action, an alteration of vascular permeability or an indirect effect on the division rate of epidermal cells. Whatever its mechanism, this relatively unimportant component of the action of cortisone is better achieved by local than by systemic administration, for the *breakdown of foreign cells in a homograft is accompanied* by congestion and disruption of its blood supply and if cortisone has been given systemically failure of the blood supply must obviously prevent it from reaching the graft

(9) Brit. M J 2 1049 1053 Nov 3 1951

The chief clinical advantage of applying cortisone locally is that it can be used in quantities that do not produce an unwelcome systemic effect Cortisone must, however, be applied to all the homografts transplanted to any one patient.

Failure of Adrenal Cortical Hormones to Prolong Survival of Homologous Skin Grafts is shown experimentally by Philip A. Weisman Anne Wight William C Quinby Jr and Bradford Cannon[1] (Boston) The current explanation that homologous skin grafts necrose despite initial vascularization because of the host s sensitivity to foreign skin suggests that secretions of the adrenal cortex might, by delaying or obstructing sensitivity prolong its survival

Guinea pigs were grafted, each with a homograft and an autograft. Biopsies of the grafts were made and all animals that died were autopsied To some, ACTH was given every six to eight hours in doses of 10-69 mg /kg /day, to others, cortisone once or twice a day in doses ranging from 4 to 125 mg /kg /day The drugs were continued until no evidence of homograft viability remained, others served as controls Only 61 guinea pigs with permanently successful autografts were included as valid. Serial eosinophil counts were also done Similar experiments were also carried out in eight young hogs.

Split thickness autografts and homografts were transplanted in three burned patients The homografts, secured from donors and from bodies within a few hours after death, had been refrigerated One of the patients, a woman, 82, received ACTH 15-25 mg intramuscularly every six hours, the others were untreated.

Autografts were generally successful in both treated and untreated animals and patients Vascularity, epithelial regeneration connective tissue growth and inflammatory cell response showed no significant differences between control and treated animals Of 18 long homograft survivals, 10 were in sick guinea pigs only two of these died after 17 days without viable grafts, whereas in most animals dissolution of homografts was advanced by this time

Because (1) ACTH and cortisone failed to prolong survival of homologous skin grafts, (2) no eosinophilia devel

(1) Plast. & Reconstruct. Surg. 8:417-4, December 1951

oped in untreated guinea pigs and (3) survival time of homografts was not decreased by repeated graftings, the immunity, or *acquired sensitivity theory found no support* Either these drugs do not inhibit development of sensitivity or immunity to homografts, or failure of homografts to survive is not due to acquired sensitivity Prolonged survival of homografts in sick animals presents the possibility that with homeostasis of the organism disturbed, ridding of foreign tissues is not as prompt as in the healthy organism. Despite failure of ACTH and cortisone to prolong survival, skin homografts remain a useful temporary dressing for the severely burned patient.

[Up to now at least there is no evidence to substantiate the idea that, in the human, homotransplantation of tissues or organs will be successful.—Ed.]

Botulism, Complication of Clostridium Botulinum Wound Infection. Colin G Thomas, Jr., Michael F Keleher and Albert P McKee[2] (State Univ of Iowa) report a case

Boy, 13 was accidentally shot in the left thigh with bird shot. The wound was promptly cleansed and several deep sutures placed in it Then 1,500 units of tetanus antitoxin was injected subcutaneously Five days later his speech was slurred and he could not cough. This progressed to dysphagia, increasing weakness of the neck, sore throat, somnolence and finally semistupor Respiratory rate was 28/minute. He could move all extremities, although weakly The seventh, ninth and twelfth cranial nerves showed bilateral paresis. Deep and superficial reflexes were bilaterally diminished. A dirty, malodorous wound, 2 cm. in diameter was present in the anterolateral aspect of the left midthigh The periosteum was absent from the visible femur but no crepitation was present in the soft tissues. White cell count was 6 150 with 68% segmented granulocytes erythrocyte count 4,040 000 and hemoglobin value 11 Gm. No fracture was seen on x ray Cerebrospinal fluid showed no significant abnormalities.

The wound was debrided. Muscles of the thigh were red and of normal consistency A piece of matted hair was removed and cultured Drainage was instituted and activated zinc peroxide paste introduced into the wound twice daily There was no response to administration of penicillin tetanus antitoxin, diphtheria antitoxin, oxygen (intranasally), dextrose and protein hydrolysate (intravenously) and blood. Cyanosis and shallow respirations were followed by death nine days after injury

Autopsy showed oblique fracture of the left femur with no displacement of fragments. The soft tissues of the left thigh showed no cellular necrosis and less inflammation than usually accompanies

(2) A.M.A. Arch. Path. 51 623-628 June 1951

gas gangrene. The brain and spinal cord were edematous, with medullary and cerebellar herniation into the foramen magnum. In addition to identifying hemolytic staphylococcus aureus, alpha hemolytic and nonhemolytic streptococci Cl. welchii and botulinum type A were identified by specific antitoxin neutralization tests. Bilateral lobular pneumonia was also present.

Botulism has no characteristic pathologic changes However thrombosis, congestion and hemorrhage of the brain and meninges are usually present probably due to respiratory failure and cerebral hypoxia Symptoms of botulism are usually explained as a curare like paralysis of motor nerves to voluntary muscles including the diaphragm and of parasympathetic nerve endings.

Cl. botulinum is a soil anaerobe of widespread distribution. Despite the prevalence of soil organisms and high incidence of contamination of wounds with other clostridia, only four cases of isolation of Cl. botulinum from traumatic wounds have been reported and these patients showed no clinical evidence of botulism. Nevertheless, in animal experiments the micro-organism has multiplied and produced potent toxin which induced botulism.

Evidence indicates that clostridia in general (including hose of tetanus and gas gangrene) are often present in ..ounds without producing toxic symptoms Isolation may be difficult because of delayed germination of spores.

Gas Bacillus Infections are reported by George R Prout and Robert B Brown[3] (U S Naval Hosp) Of 15 patients with clostridial myositis 1 in critical condition on admission, died. Symptoms included rapid bounding pulse of 106-130 temperature of 101 102 F, fetid, slightly sweet odor of wound drainage and increasing pain in and around the wound. That crepitation early in the disease was often absent may be explained by a culture report of Clostridium septique or Cl. oedematiens Of 11 patients examined roentgenographically gas was reported in 7 Infections were located in the leg in seven, the thigh in six the buttock in one and the arm in one Average time from wounding to treatment, excluding a patient with a crushing injury of he abdomen, was 2.5 days. The earlier diagnosis is made he better the chance to save life and limb Surgeons in the rward echelons should perform as complete a débride

(3) U S Armed Forces M J 2 797 801 May 195

ment as possible, avoid applying tight casts, evacuate hematomas and control hemorrhage Primary closure of war wounds should not be attempted

After obtaining a negative skin test the patient should receive 4 ampules of a trivalent gas gangrene antitoxin, each containing 10 000 units Cl perfringens, 10,000 units Cl septique and 1,500 units Cl oedematiens antitoxin Immediate operation and large transfusions of blood are often needed and large doses of penicillin, sulfadiazine and aureomycin indicated Surgery should be extensive with consideration to function and anatomy all involved muscle should be removed

Treatment of Thermal Burns of Small Extent B W Haynes Jr[4] (Baylor Univ) lists the following objectives of burn treatment

1 Prevent and combat shock.
2. Convert open contaminated wound into clean wound.
3. Cover open wound by simplest possible dressing that
   a) protects it from constant danger of reinfection,
   b) does not fix or destroy any part of skin or subcutaneous tissue which remains viable when patient is first seen,
   c) provides for drainage of serum that exudes from burned surface until it is checked by pressure or normal process of coagulation.
   d) exerts uniform moderate pressure over the burned area and
   e) can be easily removed if infection develops underneath dressing or if burn involves whole thickness of skin.
4 Keep injured part at rest.
5. Secure healing in minimal period and with minimal loss of function.

Since plasma loss into and from the burn wound depends primarily on size and depth of the wound, an accurate estimation of the area of injury is important Generally speaking, the extremes of age are most susceptible to shock after burns. Shock may be expected to occur in children up to age 6 with burns of 8 per cent and in adults with 18 per cent of body surface area Any child with 10 per cent or more and any adult with 20 per cent or more area burned should be hospitalized immediately

Immediate local therapy should be directed to avoiding further wound contamination All personnel who come in

(4) S Clin. North America 31 1283 1290 October 1951

bridement by streptokinase streptodornase and moist saline dressings and débridement. Small deep burns might be most effectively healed by excision and primary grafting The most practical method is use of intermittent moist saline dressings plus superficial débridement The dressing is best constructed by using a layer of fine mesh dry gauze next to the slough followed by sterile compresses and mechanics' waste A catheter incorporated in the dressing is irrigated twice daily with normal saline The wound is dressed every other day, and surgical débridement will assist in early removal of the slough

Once the wound has healed, passive followed by active exercises will improve function in almost direct proportion to the patient's co operation.

New Local Treatment for Burns is described by Paul E. Spangler[5] (U S Naval Hosp., Portsmouth, Va) It consists of application of a gel compound of partially hydrolized casein, sodium lactate and sodium lauryl sulfate in a layer 3/16 in. thick, which is covered by coarse mesh gauze im pregnated with zinc acetate The dressing is then secured by an elastic bandage to assure firm apposition of the dressing The gel sets in a few minutes, covering the burn with an adherent impervious, protective membrane, which produces pressure over the burned area by fixing each cell to the position it occupied when the gel set First and second degree burns are almost always healed when the dressing is removed after 10-14 days, and areas of third degree burn are usually self debrided and ready for grafting The de vitalized tissue usually lifts off with the dressing

This method known as Zinax, was used in treatment of 22 consecutive burns Spangler concluded that it is far superior to any other local treatment method It is applicable when there are a large number of burns, since a minimum of effort and time is required as compared to that involved with pressure dressings Healing is faster loss of serum less, scarring minimal incidence of infection reduced and pain ameliorated more rapidly In patients dressed promptly after injury no infection was observed

Surgical Treatment of Burns is considered by Thomas W

(5) U S Armed Forces M J 3 105-114 January 1952

Stevenson[6] (Columbia Univ) In burns destroying less than full thickness of skin there are multiple cutaneous islands which permit early healing with almost any type of dressing care A blister should not be ruptured since an intact blister has a living deeper cutaneous tissue seldom becomes infected and acts as a buffer against painful contacts A practical and comfortable dressing consists of fine meshed, ointment impregnated gauze surrounded by soft absorbent bulk and outer bandage The dressing is applied to the burn without scrubbing or débridement Hands should be placed in position of function.

Between the 7th and 14th days the dressings should be inspected One of the greatest difficulties lies in estimation of the depth of the burn and this often cannot be determined until sequestration takes place and there is a granulation surface Areas of third degree necrosis can be determined and immediate or prompt grafting done Complete loss of skin thickness requires replacement, as early as possible At the time of the first dressing the patient is in a condition of temporary equilibrium and has not yet seriously felt the effects of sepsis or depletion of vital substances through exudation. This is the best time for grafting before the wound becomes indolent and grafts take poorly

It is advisable to remove grafts at the beginning of the procedure to avoid contamination of the donor area In extensive burns it is better to proceed in easy stages rather than do too much at once The patient's cutaneous assets must be carefully evaluated in order not to use areas that will be needed later for pedicle grafts There is usually no problem in obtaining skin except when little unburned skin remains In such cases scattered small grafts may be placed over a wide area or the same donor area is cut more than once

The time factor suggests the division of burned patients into four groups. In the first group there are a small number who have deep burns in a small area. The burns can be excised and grafted immediately thus making for recovery in the shortest possible time The second and largest group

( ) New York J Med. 51 [illegible] 227 Oct 1 1951

have extensive burns, for which grafting can be started at the time of the first dressing or shortly afterward. In the third group healing is delayed and contractures are advancing and chronic Granulating wounds remain. In the fourth group, spontaneous healing occurs without benefit of grafts, with resulting contracted scars. As an alternative to excision in the second and third group, it is possible to graft on top of a granulating surface This is less satisfactory because of surface contamination, the tendency of the graft to shift and presence of a band of scar tissue between graft and normal skin which leads to delayed healing, poor appearance and interference with function

Problem of Burns in Atomic Warfare is discussed by Herman E Hilleboe[7] (New York State Dept. of Health) Two types of burns are encountered (1) flash burns from the extreme heat on the exposed surfaces of persons in the open and within 4,000 yd of the bomb center, and (2) flame burns. Clothing offers little protection against flash burns within 1,000 yd. and may be a hazard by catching fire Beyond 1,000 yd., it gives some protection, particularly clothing of the lighter shades which reflect heat. All degrees of burns are encountered in either type Explosion of stoves, gasoline tanks, gas and other combustibles may produce extensive burns therefore, safety devices and technics of self and neighbor help must be stressed.

Ultraviolet radiation absorbed by the moisture and ozone in the air causes a deep walnut stain on exposed skin by stimulation of the pigment layers or when in excess (2,000 yd from the explosion), washes out the pigment layer, leaving an albino-like skin. The flash of light from the bomb may cause temporary blindness through loss of retinal visual purple and this may affect pilots flying nearby

To cope with the disaster it is necessary to bring fires under control, rescue the injured, give first aid, give emergency treatment in the disaster area and transport the injured to improvised and emergency hospitals for medical and surgical treatment. The severe symptoms due to radiation in those not killed outright begin several days after acute exposure thus the immediate medical problem involves care of those with burns and mechanical injuries

PROCEDURE.—In the disaster area the first aid man spreads a sheet on a stretcher and, placing the burned patient on it, covers him with another sheet after loosening his clothing At the first aid station a physician removes the sheet, opening or removing clothing only if essential for inspection. After evaluation of the patient's condition morphine is administered if necessary and fluids intravenously if required when hypotonic saline solution cannot be given by mouth Otherwise the patient is given as much saline solution orally as is tolerated. The sheet is then replaced. Wounds are not dressed unless there is to be considerable delay before secondary aid is given At the secondary aid station, burns are inspected and classified (1) patient may be discharged to home or welfare center if ambulatory (2) if the condition is good, removal to a remote hospital is permitted (3) if lapse into shock threatens, fluid is administered parenterally, (4) if shock is present, administration of parenteral fluid is begun at the clearing station.

If the patient falls into categories 1 or 2, clothing is removed together with gross contamination, but débridement is not performed. Hypotonic saline solution is given orally a fine mesh gauze dressing or a sheet is applied, on top of which absorbent bulk such as turkish toweling is placed. The lesion is bandaged with 4 in. non elastic gauze bandage If the newly developed burn dressing is available it may be used instead and bandaged with weakly elastic adhesive bandage. If the patient is in category 3 he is evacuated to the emergency hospital without applying additional dressing unless pressure of work permits. The patient must remain at the station for a while, in which case those in categories 3 and 4 can also receive the burn dressing as described.

It is important to remember that surgeons cannot work without equipment antibiotics, drugs and blood services. Stockpiling at strategic points throughout the country is essential. By concerted planning emergency medical teams suppliers and many voluntary medical aides and assistants, death and disability can be reduced

Experiences with Exposure Method of Burn Therapy T G Blocker Jr., Virginia Blocker S R Lewis and C S Snyders (Univ of Texas) treated 103 patients by open air and 103 with pressure dressings The two groups were similar in all other respects, and general care of the patients was the same with regard to fluid, blood, vitamin and nutritional therapy The study was made because of the realization that properly applied pressure dressings would not be practical in a major burn disaster

Patients with major burns (over 20% of body surface)

(8) Plast. & Reconstruct. Surg 8 87 93 August, 1951

on open air therapy required an average hospitalization of 6 weeks as compared with 12½ weeks for those treated by dressings. Also, in burns of less than 20%, the exposure group healed more quickly Of the open air patients, 46% had some full thickness burns which required grafting, as compared to 69% of those treated with dressings This was thought to be due to later regeneration of skin in areas which were originally estimated to be third degree burns. Closed technic is presumed to destroy by infection deeply located islands of epithelium which were damaged but still viable at the time of injury In major burn patients treated by dressings, significant elevation of temperature (above 100 F) persisted for an average of five weeks, whereas patients on open air therapy had an average of less than two weeks of fever The open air method reduced morbidity but not mortality In the two groups percentage of patients receiving blood was the same, but total blood requirements were much less in the open air one

The authors consider the exposure method most satisfactory for treating acute burns, both mild and severe which can be adequately exposed and protected It should be feasible for handling large numbers of burn casualties with a minimum of trained personnel and equipment if extensive wounds of other types are not present. It does not solve the problem of large deep circular burns of the trunk and legs, and it is contraindicated in patients with old, chronic burns, since raw, granulating surfaces cannot be exposed to the air without protective coverings

Disinfectant Barrier in Dressings Applied to Burns was studied by E J L. Lowbury and A. M Hood[9] (Birmingham, England)

METHOD —In most experiments the model wound and dressing consisted of a glass tube ½ in. diameter and 3 in. long, plugged at one end with ½ in. absorbent cotton-wool, covered with four layers of crepe bandage firmly tied in contact with the cotton wool (Fig 3) Cotton wool or bandage impregnated with disinfectant were compared with unmedicated controls, both exposed to the same organism simultaneously Phenyl mercuric bromide, nitrate and acetate and octyl cresol were used as disinfectants and strains of Streptococcus pyogenes, Staphylococcus aureus, Pseudomonas pyocyanea, Proteus vulgaris and Bacterium aerogenes as test organisms.

(9) Lancet 1 899-901 May 3 1952.

Dressings were soaked with sterile 50% horse serum in nutrient broth dropped by pipet on the inner surface of the cotton wool until the outer surface of the crepe bandage was visibly moist. A drop of 24 hour broth culture of the test organism was then delivered to the inner surface of the saturated cotton wool. The tube projecting through a cotton plug into a large boiling tube, was placed on its side in an incubator at 37 C and the outer layer of the covering bandage was sampled with a moist swab after six hours, then daily for a week. The bandage was also tested before swabbing for moisture by touching it with sterile filter paper. If it was dry, sterile 50% serum broth was added from the inside until moisture was apparent on the outside and a drop of broth culture of the test organism was added. The experiments were designed to study possible prevention of passage of organisms through dressings soaked by sterile exudate.

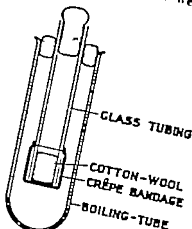


Fig. 3 —Small model dressing. Cotton-wool and crepe bandage (inside boiling tube) treated with disinfectants, for comparison with untreated control dressings. (Courtesy of Lowbury, E. J. L., and Hood, A. M. Lancet 1 890-901 May 2 1953)

Tubes with unsoaked dressings were dipped into beakers containing 24 hour cultures in 50% serum broth and the dressing allowed to become soaked with culture fluid. Tubes were left standing with the "dressing" submerged in culture fluid. The inner surface of the cotton wool was swabbed on the appearance of moisture then every hour for six hours and finally after 18 hours of incubation at 37 C.

The experiments were designed to test possible prevention of passage of bacteria through dry dressings when they became soaked with infected exudate.

In the one week none of the organisms tested grew "through" cotton wool treated with phenyl mercuric bromide and kept moist with sterile serum broth. All of the organisms grew through the untreated control cotton wool. Treatment of cotton wool with octyl cresol and other phenyl

on open air therapy required an average hospitalization of 5 weeks as compared with $12\frac{1}{2}$ weeks for those treated by dressings. Also in burns of less than 20% the exposure group healed more quickly. Of the open air patients, 45% had some full thickness burns which required grafting as compared to 62% of those treated with dressings. This was thought to be due to later regeneration of skin in areas which were originally estimated to be third degree burns. Closed technic is presumed to destroy by infection deeply located islands of epithelium which were damaged but still viable at the time of injury. In major burn patients treated by dressings, significant elevation of temperature (above 100 F) persisted for an average of five weeks, whereas patients on open air therapy had an average of less than two weeks of fever. The open air method reduced morbidity but not mortality. In the two groups percentage of patients receiving blood was the same but total blood requirements were much less in the open air one.

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(9) Lancet 1 [illegible] May 8 [illegible]

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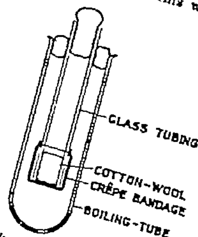


Fig 3.—Small model dressing Cotton-wool and crepe bandage (inside boiling tube) treated with disinfectants, for comparison with untreated control dressings. (Courtesy of Lowbury, E. J. L., and Hood, A. M. Lancet 1 899 901 May 3 1952.)

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mercuric salts and treatment of crepe bandage with phenyl mercuric bromide did not provide a reliable disinfectant barrier In the second type of experiment, all types of organism could be detected in samples taken from the inside of the cotton wool dressing treated with phenyl mercuric bromide immediately after the appearance of moisture and for periods ranging from one hour (Ps pyocyanea) to six hours (P vulgaris and Bact. aerogenes) After 24 hours, however no organisms could be isolated from the inside of the dressings.

Perhaps contamination of sterile burns through soaked dressings can be prevented by using a layer of cotton wool medicated with phenyl mercuric bromide A disinfectant barrier of this sort excels plastics in that evaporation from the dressing is unimpeded The value of such dressings as a barrier to the passage of organisms from an infected burn through soaked dressings is more doubtful. Phenyl mercuric salts have low toxicity to animals and the bromide is relatively insoluble in water

Effect of Soaps Containing Hexachlorophene on Wounds and Burned Surfaces. R. Russell Best, John D Coe and George B McMurtrey[1] (Univ of Nebraska) produced wounds in rabbits and mice by incision, abrasion and burning The wounds were washed with bland bar soap same bland bar soap containing 2 per cent hexachlorophene, liquid soap containing no hexachlorophene, same liquid soap containing 5 per cent hexachlorophene or same liquid soap containing no hexachlorophene but containing 5 per cent alcohol

Presence of hexachlorophene in soap did not delay wound healing and no unusual amount of tissue reaction was noted. The liquid soap containing alcohol caused a far more striking tissue reaction. Survival experiments on mice with fresh wounds contaminated with virulent streptococci showed that hexachlorophene or alcohol soaps can delay or prevent early septicemia No essential difference was noted between the effects of the bar and liquid soaps containing hexachlorophene

It was concluded that use of tincture of green soap which contains six times as much alcohol as the soap used in these

(1) A.M.A Arch. Surg 62 895 902 June 1951

experiments, should be discontinued, although it is effective against pathogens. A soap containing hexachlorophene is more ideal, both for washing the skin about the wound and for washing the wound itself. The usual technic of final irrigation of the wound with sterile water or saline solution should be carried out.

[The literature on the treatment of burns goes on and on. New ideas proposed and refuted. Old ideas resurrected, praised and refuted. Ho hum! —Ed.]

Use of Enzymatic Agents in Débridement of Burn and Wound Sloughs. James F. Connell, Jr., and Louis M. Rousselot[2] (New York City) found the enzymes streptokinase and streptodornase, derived from streptococcic organisms, effective in lysing susceptible portions of wound exudates and sloughs in a variety of surgical lesions. Streptokinase appears to catalyze the transformation of plasminogen to plasmin, an active fibrinolysin in human plasma. This reaction occurs in a few minutes as measured by its lysis of a plasma clot in a pH range of 7.0-8.5 at 37.5 C. The enzyme is readily soluble in water, saline or zephiran,* and its activity at body temperature lasts 20-24 hours. Proteolysis of fibrinous material by this enzyme requires the presence of serum and that the pH of the exudate be kept in the optimal range. To maintain continuous activity, acid exudates may require that the enzyme be suspended in a N/10 phosphate buffer. Streptodornase liquefies desoxyribose nuclear protein. Exudates with this protein are characterized by a stringy, viscid coagulum. The enzyme has no fibrinolytic activity and works best at a pH of 7.0-8.5. A satisfactory dose of each is 20,000 units/cc streptokinase and 7,000-10,000 units/cc streptodornase diluted in suitable menstruums. Except for occasional hyperthermia with or without a preceding chill and transient nausea, no toxic manifestations have been noted.

The enzymes have been used on 12 burns and 21 wounds. They were incorporated in Lubafax and placed over the wound. Fine mesh gauze impregnated with petroleum jelly was applied as a mechanical barrier to prevent diffusion of the active materials. All abscess cavities or sinus tracts were intubated with catheters, and volumetric changes were

(2) Surgery 30:43-55, July, 1951.

measured daily. The enzymes, dissolved in normal saline or Lubafax, were instilled daily. In burns and wound sloughs it was necessary to crosshatch the slough so that the enzymes could reach their specific substrates.

Collagenous material, epithelial cells and fibroblastic cells are not in the spectrums of the proteolytic activity of the enzymes. The enzymes must be replenished at least every 24 hours or earlier, depending on the amount of concomitant exudate transudate elaborated by the lesion. Local use of antibiotics may be justified as the dead tissue foci are removed.

Of the 33 patients treated, 18 had excellent, 9 good, and 4 fair results, and 2 were unimproved. In burns, lysis of the fibrinous coagulum in the meshes of the collagen strands, which bind the slough to the viable tissue below, loosens the small blocks of slough and thus permits atraumatic, nonpainful excision to be carried out. There seems to be no inhibiting effect on cell migration, because rapid epithelization occurs in the presence of the enzymes. Postoperation wound sloughs are secondary to hematoma, traumatic handling of the tissues, septic contamination of the wound or excessive tension. Removal of the nutrient debris by the enzymes lowers bacterial flora. Ulcerations secondary to ischemia and denervation have sloughs of various collagenous substrates. When secondary infection is present the slough and exudate are in the substrate spectrums of the streptococcic enzymes. Streptokinase and streptodornase have produced rapid healing. In large chronic abscesses, the enzymes thin the viscid exudate, decrease bacteria and remove slough, thus bringing about the collapse of the cavity.

NEOPLASMS

Biopsy in Cancer Diagnosis, whether by removal of an entire tumor or a small wedge of tissue from the edge, including adjacent normal tissue, or by aspiration with a syringe and large bore needle, is discussed by Lewis B. Woolner and John R. McDonald[3] (Mayo Clinic). In general,

(3) S. Clin. North America 31: 947-958, August, 1951.

excision with a sharp scalpel without distortion of tissue cells, incorporating in the specimen surface mucosa or epithelium for orientation, is the best method of obtaining a specimen. Unless frozen section is to be used the removed tissue is placed immediately in 10 per cent Formalin. When an inflammatory lymph node may be involved, a second portion of tissue is placed in a sterile container for bacteriologic study should histologic findings indicate the need Danger of disseminating tumor cells by properly performed biopsy has not been substantiated to permit rough palpation of a tumor or to allow it to remain undiagnosed presents a greater risk.

Lymph nodes when there is a choice of site, are preferably taken from the neck. The node should be removed intact and examined in paraffin section. Frozen section is useful in metastatic malignancy and for determining granulomatous inflammation so that the material may be cultured Aspiration is not satisfactory for diagnosis of primary malignancy of lymph nodes

Recognition of carcinoma in situ of the cervix a lesion which progresses to invasive carcinoma in 1 10 years, represents an advance in the pathologic study of tumors A positive result of cytologic examination calls for confirmation by biopsy Although this lesion occurs most often at the squamocolumnar junction, a single random biopsy specimen is inadequate. Selection of appropriate areas for biopsy is aided by Schiller's iodine test since areas of erosion, leukoplakia and carcinoma in situ take no stain. If, as rarely occurs, the lesion is in the endocervix scrapings from the endocervical canal are needed for diagnosis

Cytologic examination often gives a false negative result in carcinoma of the uterine fundus Adequate sampling of uterine scrapings for examination (after dilatation and curettage) is essential.

The adenomatous polyp of the large bowel is often a precancerous lesion, since many such polyps show areas of atypical glandular proliferation resembling carcinoma Nevertheless, until actual invasion of the stalk or underlying mucosa the lesion cannot metastasize Infiltration in such lesions must be ruled out and microscopic examination of the stalk is essential Similarly presence or absence of in

filtration from villous neoplasms of the bladder should be assessed

Examination *for bronchogenic carcinoma includes* bronchoscopic biopsy, sputum study and/or exploratory thoracotomy Exfoliative cytology is especially useful in lung malignancy, which often is inaccessible to bronchoscopic biopsy, since it provides evidence of malignancy in over 70 per cent of cases *Peripheral lung carcinoma is best* diagnosed at thoractomy by frozen section.

Breast lesions should be studied by biopsy in the operating room, with frozen sections Radical surgery should not be done without previous biopsy since noncancerous lesions may even show skin attachment. Sclerosing adenosis, cystic disease with intraductal and intracystic proliferation, comedo mastitis and lobular carcinoma in situ all present special difficulties in diagnosis even *for the expert*

Paget's disease of the nipple is carcinoma in situ associated with carcinoma of the underlying ducts. When Paget's disease is diagnosed, radical mastectomy is to be done although, theoretically, simple mastectomy would suffice *if it could be proved that the carcinoma is confined to* the ducts. Similarly in comedo carcinoma and extensive ductal carcinoma, proof of absence of infiltration is difficult.

All skin lesions should be examined microscopically on removal, with sufficient surrounding tissue included to identify the lesion and determine absence of infiltration. Bowen's disease of the skin and erythroplasia of Queyrat of the glans penis represent carcinoma in situ of the skin. Certain other skin lesions, including *keratoses, cutaneous horns,* xeroderma pigmentosum and leukoplakia, are precancerous in that they develop into cancer in a varying percentage of cases. Pigmented lesions of palms, soles or genitalia are dangerous and should be removed prophylactically as should any ulcerating darkening or growing pigmented lesion, for it is suggestive of malignant melanoma. The flat nonhairy junctional pigmented mole is often precancerous

Biopsy material may be obtained by aspiration or by actual surgical exploration for bone tumors although it may be impossible when the bone is sclerotic or has an expanded cortex. Aspiration biopsy is valuable in metastatic carcinoma or hypernephroma in bone Sternal aspiration is used in

diagnosis of multiple myeloma Frozen sections of bony or cartilaginous tissues are difficult to cut, stain and interpret

[It is good to have this candid statement from the Mayo Clinic about the value of biopsies and frozen sections Much unnecessarily radical surgery has been performed because of the overemphasis on the danger of spreading cancer by the performance of biopsy Dr W J Mayo in the early years of this century was probably the first surgeon to recognize the value of frozen sections in the operating room. The improvements in the technic of making the sections which were devised by Bardeen the professor of anatomy at the University of Wisconsin, made the whole procedure a practical one for the surgeon.—Ed.]

Hormone Therapy of Cancer is discussed by Don Carlos Hines[4] (Indianapolis) Cortisone and ACTH should be avoided in malignancy except for acute myelogenous leukemia or lymphosarcoma, Hodgkin's disease and multiple myeloma in the young who sometimes improve temporarily Sex hormones, either administered or withdrawn by surgical removal of gonads or ovaries, influence malignancy of secondary sex organs, namely the prostate and breast

Prostatic cancer, although the only hope of cure lies in early diagnosis and complete surgical removal, sometimes responds dramatically to castration and/or estrogen Eventually however, relapse occurs even after some years of remission following hormone therapy Withdrawal of androgen by castration appears to cause atrophy of prostatic epithelium Estrogen probably inhibits pituitary output of gonadotrophin, thereby inhibiting testicular production of androgen. Diethylstilbestrol is the favored estrogen, given in oral doses, 1 mg three times a day increased temporarily to 12 mg a day if necessary and then reduced to 1 mg daily for maintenance after maximal clinical improvement. Hormonal therapy may turn an inoperable patient without metastasis into an operable one Except for this purpose hormonal therapy is generally withheld until symptoms appear In case of relapse the alternate mode or both castration and estrogen, may be used.

Breast cancer's only hope of cure also lies in early prompt surgery but irradiation or hormone therapy are palliative Irradiation is preferable to hormone therapy for less widespread metastases, but for lung metastases or widespread bone or soft tissue metastases, hormone therapy is used. In premenopausal women the hormonal treatment of choice is

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(4) Pennsylvania M J 54 1046 1051 November 1951

ovariectomy. In the first five years after menopause androgen (testosterone propionate 50 mg three times weekly intramuscularly) is preferred. More than five years after menopause androgen is used for bone metastases causing pain or anemia, whereas estrogen (diethylstilbestrol 15 mg orally a day) is given for inoperable primary tumors or metastases to lung or soft tissue; these respond (if at all) within four months. Hormone therapy should be continued until the disease is reactivated. Regression may then be induced by cessation of previous therapy with or without use of another hormone. Irradiated tumors may prove resistant to estrogen therapy even though nonirradiated lesions in the same patient respond. Contrariwise lesions which have responded to estrogen may later poorly tolerate irradiation. In the male breast cancer may respond to castration or estrogen palliation. Edema, hypercalcemia or nausea may supervene with large doses of hormone. Restric*tion of salt may suffice to reduce edema but sometimes* the steroid has to be discontinued temporarily. Serum calcium should be followed and therapy discontinued in case of hypercalcemia.

Other forms of cancer are not amenable to hormone therapy except for chorioepithelioma which responds to large doses of estrogen.

Tumors of Childhood: Surgeon's Viewpoint. On the basis of a survey of 175 tumor cases encountered in a *children's* hospital from 1946 to 1949 (2.5% of total admissions), Clare Gray Peterson and Graham Gilmer, Jr.[5] (Portland, Ore.) draw three general conclusions. (1) More radical treatment of childhood malignancy is justified by the fact that the death rate for malignancy is high whereas the risk of major surgery is no longer excessive. (2) Whatever aggressive treatment is used must be based on unanimity of opinion regarding the diagnosis of malignancy. (3) Every childhood tumor should be removed and studied histologically because some benign tumors are clinically malignant and others may undergo malignant change.

Operability is based on four criteria: the tumor's biologic characteristics, the surgeon's philosophy and ability, the calculated operative risk and the basic principles of cancer

(5) Surgery 30: 329-348, August, 1951.

surgery, namely, that all macroscopically evident tumor should be widely excised since cures have been reported in almost every form and site of malignancy Early and proper treatment carries an increasingly good prognosis Furthermore, inoperability must be based not on lack of moral courage in the surgeon but on the extent of physiologic strain in the patient that is within recoverable limits Normal anatomic structures are to be regarded as expendable in cancer surgery

The biologic characteristics of childhood tumors are often unpredictable Biologically inoperable and radioresistant are challengeable terms The embryonal undifferentiated character of childhood malignancies disparity between histology and clinical course, high percentage of radiosensitive tumors (despite histologic predictions) and unexpected survivals and apparent cures of "inoperable" or incompletely removed tumors after x radiation are noteworthy All nonoperable or nonresectable tumors deserve a trial of x radiation therapy

The only lesions not to be irradiated are melanoma, astrocytoma (unless inoperable or not resectable) and acute lymphatic leukemia for which aminopterin therapy is indicated Combined surgery and radiation are indicated for bilateral retinoblastoma, enucleating one eye while irradiating the other, teratoma or seminoma of the testis, and Ewing's bone tumor with postoperative irradiation for dysgerminoma of the ovary neuroblastoma and Wilms' tumor Radiation alone is to be used for lymphoma, oro- and nasopharyngeal carcinoma medulloblastoma and inoperable or nonresectable malignancies

Although hemangioendothelioma is classified as benign, it may be said to act malignant by showing rapid growth, tendency to recurrence after excision or local invasion of vital structures or even by causing death from severe hemorrhage Four categories of tumors may thus be described (1) histologically benign clinically malignant, such as hemangioendothelioma, (2) histologically benign-clinically benign (3) histologically malignant-clinically malignant and (4) histologically malignant-clinically benign, e.g juvenile melanoma and the rare neuroblastoma which disappears without treatment or spontaneously changes into

a benign tumor type Unfortunately there are, in addition, pediatric tumors which cannot be diagnosed histologically

The dangerous lesions of childhood for which prophylactic removal is advised include (1) the junctional nevus, particularly when situated below the level of the umbilicus or on the palm or sole, (2) nerve sheath tumors, (3) chondromas, particularly if symptomatic or subject to trauma, (4) dermoid cysts and teratomas, (5) tumors of the head and neck such as retinoblastoma, adenoma of the thyroid and branchiogenic cysts and sinuses (6) mediastinal tumors, the mediastinum being a critical area, (7) abdominal tumors such as neuroblastoma and Wilms' tumor, (8) adenomatous polyps, particularly of the colon, and (9) ectopic testis, which is 50 times as likely to become malignant as the normally placed testis

Desmomas of Abdominal Wall in Children. The general concept of a desmoid tumor is that of a fibroma arising in the musculoaponeurotic sheath of the abdominal wall, characteristically in women during active sex life, in relation to a preceding or current pregnancy or in the scar of an abdominal operation Actually similar neoplasms appear in extra-abdominal locations. Occasionally they are present in nulliparas, males or children.

Robert J Booher and George T Pack[6] (Memorial Cancer Center) add 8 cases of desmoid tumor of the abdominal wall in children to the 16 in the literature Histologically, the neoplasms were not malignant. On the basis of the clinical course, two were not considered benign because of uncontrolled invasion. The neoplasms recurred, despite what appeared to be complete excision histologically as determined by gross evidence of striated muscle entirely around the specimen, and excision of full thickness of the abdominal wall. Although hormonal assays of the tumors were not possible and ketosteroid determinations were not done the otherwise grossly normal characteristics of the three patients indicated that a normal hormonal titer was present in each It seems unnecessary to postulate a hormonal factor in etiology of the tumors.

Every relatively cellular fibroma, no matter how casual its clinical or histologic appearance, should be considered

(6) Cancer 4:1052 1065 September 1951

malignant until its subsequent behavior has been established Radical excision must be the first attack, without primary concern for the problem of closure of the wound

Retroperitoneal Teratomas in Infancy and Childhood are discussed by Ernest E Arnheim[7] (Mount Sinai Hosp., New York City) Teratomas have been thought to arise from abnormal tissue primordia in early embryonic life which undergo chaotic differentiation into a variety of tissues or again as a result of disturbances of the primitive streak since the tumors arise in an immediately preaxial median or paramedian position from the base of the skull to the coccyx Teratoid tumors contain representatives of the embryonal elements—ectoderm entoderm and mesoderm—with no evidence of orderly delamination. Almost all teratomas are tridermal containing skin, teeth, nerve tissue respiratory or alimentary epithelium and connective and vascular tissue The most benign tumors consist of fully mature tissues with no sign of proliferative activity, the most malignant ones contain abundant immature embryonic tissues A malignant tumor may arise from one of the previously quiescent tissues of the growth or may be a property of the whole growth

Retroperitoneal teratomas are usually large cystic growths which arise high in the retroperitoneal space on one side or extend into both sides. A review of 44 cases, including 30 from the literature, showed 11 tumors on the right side, 19 on the left and 14 on both sides Large retroperitoneal teratomas cause death by pressure effects 13 were found at autopsy Malignant changes were seen in three cases Twenty three of the patients were under age 1 year and 26 were females.

Abdominal enlargement and a palpable mass were the commonest findings. Symptoms were predominantly due to pressure from the tumor The masses were usually large and firm, of limited mobility and ballotable into the lumbar region Dilated veins were noted occasionally in the abdominal wall. Roentgen studies, done in 12 cases, revealed areas of ossification in the tumor in 9 intravenous or retrograde pyelography showed kidney or ureter displacement

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(7) Pediatrics 8 309 327 September 1951

Retroperitoneal teratomas are the third most frequent retroperitoneal tumor in childhood, neuroblastoma sympathicum and Wilms' tumor being more frequent These two must be considered in differential diagnosis.

Treatment is operative removal A transperitoneal transverse, liberal incision is the best approach for excision of the tumors. There were 9 deaths in the 31 operations, usually due to incomplete removal hemorrhage and shock. Of the 19 children discharged from the hospital after removal of benign retroperitoneal teratomas, 4 have not been followed 2 died within one year 3 were well in less than a year 6 were well from one to two years and 1 each was well at two four five and eight years after surgery The three children with malignant tumors survived operation but two died of recurrences and metastases in less than seven *months and one was not followed.*

Pathology and Classification of Tumors of Soft Tissues, according to Arthur Purdy Stout[8] (Columbia Univ), has been inadequate because the soft tissues have been poorly understood and inadequately studied Some tumors are pain producers like the glomus tumor the cutaneous and subcutaneous leiomyomas and multiple painful lipomatosis. Lipomas attain great size and, although chemically indistinguishable from normal body fat, their fat is unavailable to the body as energy Because the new collagen in them tends to contract many tumor like fibromatoses produce bizarre deformities such as congenital wryneck, the proliferative form of Dupuytren's contracture Peyronie's disease or penile fibromatosis, keloids, desmoid tumors and progressive fibrous myositis. Most tumors can only be diagnosed histopathologically

About 75% of primary malignant tumors of the soft tissues are fibrosarcomas, liposarcomas, malignant vascular tumors and myxomas (table) Metastasis, when it occurs, is most commonly via the blood stream. Occasionally metastases pass through lymphatics and lodge in regional lymph nodes, but this happens so seldom that routine resection of the nodes is unwarranted unless clinical evidence shows involvement. Greatest hope of cure depends on successful removal of the primary growth before metastasis.

(8) Am. J Roentgenol. 66-903-909 December 1951

Primary Malignant Tumors of Soft Tissues, 616 Cases

Type of Tissue	Benign	Malignant	Cases	Malignant from Benign	Recurrence %	Metastasis %	Died %
Fibrous tissue	Fibroma Fibromatoses	Fibrosarcoma	222	Occasionally	31.7	6.9	17.2
Adipose tissue	Lipoma	Liposarcoma	115	1 case	66.0	31.0	37.0
Smooth muscle	Leiomyoma	Leiomyosarcoma	25	?	90.0	30.0	80.0
Striated muscle	Rhabdomyoma (?)	Rhabdomyosarcoma	38	?	85.0	40.0	65.0
	Granular cell myoblastoma	Granular cell myoblastoma	5	?	yes	yes	yes
Blood and lymphatic vessels	Hemangioma (all types)	Angiosarcoma incl hemangioendothelioma (18) hemangiopericytoma (41) Kaposi's disease (22)	81	Never seen	60.0	36.0	36.0
Synovial mesothelium lymphatic and reticulo-endothelial tissues	Lymphangioma Synovialoma (?) Xanthoma	Synovial sarcoma	13	?	yes	yes	yes
		Lymphosarcoma (incl. mycosis fungoides)	23	Never seen	yes	yes	yes
	Xanthogranuloma Giant cell tumor	Reticulum cell sarcoma	21	Never seen	yes	yes	yes
		Plasmocytoma	1	Never seen	yes	yes	yes
Mesodermal melanoblasts	Blue nevus	Melanosarcoma	1(?)	?	no	no	no
Undifferentiated mesenchyme	Mesenchymoma	Myxoma	50	?	56.0	0	6.0
		Mixed mesodermal tumor	19	Never seen	40.0	60.0	60.0
Heterotopic bone and cartilage	Myositis ossificans Osteoma Chondroma	Osteogenic sarcoma	1	Never seen	yes	yes	yes
		Chondrosarcoma	1	Never seen	yes	yes	yes
Nerve sheath	Schwannoma	Schwannoma	20	Yes (from neurofibroma)	yes	yes	yes
	Neurofibroma	Neuroepithelioma (all types)	7	Yes (from neurofibroma)	yes	yes	yes

Fibrosarcoma is not as malignant or fatal as generally believed Of 145 fibrosarcomas, only 10 metastasized and only 25 caused death. Over half recurred locally, indicating inadequate primary treatment

Sarcomas are of two kinds depending on amount and thickness of connective tissue fibers formed, degree of resemblance to proliferated scar tissue and relative number of mitoses. The recurrence rate for *soft tissue sarcomas* in Stout's group was 61% Treatment fails because surgeons *do not realize that such tumors have cells extending far* beyond palpable confines of the tumor Careful biopsy is essential. *Adequate treatment requires that the excision* line extend 3 cm. or more beyond palpable tumor limits at *all points The most radical surgery is indicated for poorly* differentiated fibrosarcomas, rhabdomyosarcoma, synovial *sarcoma malignant hemangioendothelioma lymphangiosarcoma*, malignant mesenchymoma poorly differentiated liposarcoma, *osteogenic sarcoma and chondrosarcoma*, reticulum cell sarcoma and leiomyosarcoma. Amputations are not *necessary for myxoma, differentiated liposarcoma, melanosarcoma* or fibrosarcoma of the skin, because they do not *metastasize however broad excision is essential* because of frequent recurrence

Tumors which are somewhat radiosensitive are Kaposi's disease reticulum cell sarcoma, lymphosarcoma, small liposarcomas *and* plasmacytoma, but *cure is rare except for* reticulum cell sarcoma and lymphosarcoma

Malignant Melanoma. Mims Gage and William Dawson[9] (New Orleans) list the anatomic sites most often involved by malignant melanomas in order of frequency as the lower extremity head and neck, trunk, upper extremity and eye Pigmented lesions in these sites, except the eye, should be considered malignant or borderline Those in the eye and on the soles, palms, scrotum or vulva or beneath the finger and toenails should be considered, from a prophylactic standpoint, malignant when first seen. The lesions have been classified as junctional nevus (dermoepidermal) intradermal nevus (common mole or neuronevus), blue nevus (Jadassohn Tieche) compound nevus and juvenile nevus.

The histologic difference between benign and malignant

(9) Ann. Surg. 133 772 782 June, 1951

nevi depends entirely on the size, shape of cell and size of nucleus and nucleolus There are many mitoses in malignant melanoma. The same tumor may contain carcinoma and sarcoma cells.

The melanotic mole occurring before puberty histologically appears to be malignant yet is benign clinically After puberty these juvenile melanomas take on renewed growth and have all the local and metastasizing characteristics of the adult type Malignant melanomas that metastasize via the lymphatics show local and regional dermal and epidermal spread and regional lymph node involvement. When there is mitosis of malignant cells around the blood vessels and large vascular sinuses, the cells tend to break into the blood vessels, resulting in widespread metastasis via the blood stream, primarily to the lungs and liver

The difference between benign and malignant pigmented nevi is one of degree in cellular activity When the benign melanoma is of the dermoepidermal type there are cells in both the epidermis and the dermis that are foreign to the other normal cellular constituents and are frequently called malignant because of the presence of pigmented cells In the malignant form the cellular distribution is similar but the cells are more embryonal and contain a larger nucleus and prominent acidophilic nucleoli.

Transformation of a benign nevus to a malignant one is evidenced clinically by a change in color increase in size and inflammation or ulceration. Any change that can be detected clinically in a previously quiescent pigmented mole should be considered malignant Also all pigmented moles in areas subject to trauma should be considered malignant

Treatment of malignant melanomas should be as radical as the patient's condition will permit Biopsy should never be done on benign lesions Cautery coagulation with the electric needle, radium and roentgen rays should never be used for benign nevi since they often precipitate a comparatively benign lesion into a full blown malignant one with early metastasis. All juvenile melanomas should be removed before puberty All melanotic moles on the palms, soles, scrotum or vulva, beneath the finger and toenails and in the eye and all moles subjected to constant trauma by cloth

ing should be removed with a wide segment of the integument and underlying fascia Malignant melanomas of the body, hand arms, head and neck, scrotum vulva legs and feet with no regional lymph node involvement should be treated by wide excision of the primary growth with fascia and lymph node dissection For local recurrence or a widespread local lesion with metastatic regional node involvement of the upper or lower extremity, amputation with regional node dissection or fore and hindquarter ablation of the extremity is indicated Wide excision and bilateral inguinal and iliac node dissection are indicated for malignant lesions of the scrotum, and vulvectomy and bilateral inguinal and iliac node dissection, for malignant melanomas on the vulva.

A local anesthetic should never be used for local excision.

Chemodectoma ("Nonchromaffin Paraganglioma") of Mediastinum Douglas K. Duncan and John R McDonald[1] (*Mayo Clinic and Found*) *report two cases. Only three have* previously been reported Chemodectoma is a neoplasm consisting of chemoreceptor cells, which are associated with parasympathetic nerves and structures connected with afferent nerve fibers, which originate in the adventitia of blood vessels in structures intimately connected with afferent nerve fibers, or which occur along the branches or in the ganglions of the glossopharyngeal and vagus nerves.

Analogous to the carotid body is the mediastinal chemoreceptor structure called the aortic body Mediastinal chemoreceptor bodies are found near the innominate artery either close to the bifurcation of the subclavian and common carotid arteries or lateral to the right subclavian artery; on the anterolateral aspect of the left portion of the aortic arch near the origin of the left subclavian artery near the pulmonary end of the ductus arteriosus, and/or on the right posterior surface of the pulmonary trunk in relation to the ascending aorta and left coronary artery Chemoreceptor bodies respond to decrease in oxygen tension, decrease in pH increase in temperature and certain drugs.

CASE 1—In a youth 18 an x ray showed a tumor in the right side of the thorax posteriorly at the level of the ninth and tenth thoracic vertebrae It caused pain in the right upper quadrant of

(1) Am. J Clin. Path. 21 516 520 June 1951

the abdomen. An extrapleural tumor measuring $7 \times 5 \times 4$ cm., the surface of which was covered with large dilated vessels was removed surgically On histologic examination, silver reticulum stain showed reticulum fibers separating the nests of cells, but did not reveal any fibers penetrating the individual cells (Fig 4) Through out the tumor there were scattered areas of necrosis.

CASE 2.—Woman, 33, had no symptoms referable to the chest. An x ray showed a rounded mass posteriorly in the right hemi



Fig 4—Chemodectoma. Gömöri reticulum stain × 165 (Courtesy of Duncan, D K. and McDonald, J R. Am. J Clin. Path. 21 515-520 June 1951)

thorax adjacent to the sixth seventh and eighth thoracic vertebrae A large semisolid extrapleural tumor at the level of the seventh thoracic vertebra was removed surgically It had gross and histologic characteristics similar to the tumor in Case 1. Spastic paraplegia of both legs and sensory impairment below the fifth thoracic segment developed 14½ years later. an x ray disclosed a large, ovoid para vertebral mass at the level of the seventh thoracic vertebra, with total destruction of that vertebra. No further treatment was given nor was a biopsy specimen obtained.

Abdominal Neuroblastomas Thomas N Poore Malcolm B Dockerty Roger L J Kennedy and Waltman Walters[2] (Mayo Clinic) discuss 20 patients who were operated on Neuroblastomas are defined as malignant tumors arising from the cell series that is formed as the primitive sym pathogonia different-ate to form the adult cells of the sym pathetic nervous system and adrenal medulla Although most of these tumors arise from the adrenals, such an origin is not always obvious due to size of the tumor and distor

( ) S Clin. North America 31 1121 1141 August 1951

tion of the anatomic relations. Two tumors were renal in origin and three invaded the kidney Sixteen patients were children, and average age of these was 5 2

The usual symptoms were abdominal pain, weight loss, and a large, hard, nodular, abdominal tumor Elevation of temperature (never over 101 6 F) was present in five patients Anemia was usually present, with an average hemoglobin value of 9 8 Gm and red cell count of 3,580,000 Excretory urography was of diagnostic value, giving positive results in 12 of the 14 patients on whom it was carried out, it often revealed a calcified mass displacing the kidney downward. Calcification was present in the primary tumor of 7 of 12 patients, in contrast with Wilms' tumor, the tumor most often confused clinically X rays of neuroblastomatous metastasis of the long bones are similar to those of Ewing's tumor and osteogenic sarcoma.

Laparotomy was performed on 16 patients but resection on only 6 Complete removal of the tumor was believed to have been accomplished in only four Nine patients received x ray therapy which in some resulted in striking palliative shrinking of the tumor Metastatic lesions were found chiefly in lymph nodes, the liver the orbit, and the lungs and long bones in that order of incidence No definite evidence of asymmetry of metastasis, such as was reported by Frew, was found

Grossly the tumors are large, rounded, encapsulated, solid masses with pronounced lobulation, much necrosis and hemorrhage, and specks of calcification (Figs. 5 and 6) Microscopically they are characterized by variation in cellular maturity and most tumors contain areas of all types (1) the immature or embryonic type with dense cellular masses of small, dark cells (2) more mature areas with oval or polarized cells, and (3) most mature areas filled with bands of fibrils and nests of almost mature ganglion cells among the bands According to Broders method of grading malignancy, there were 5 grade 4 neuroblastomas (areas of immature or embryonic cells predominate) 12 grade 3 neuroblastomas (much diversification but predominance of polarized cells) and 3 grade 2 neuroblastomas (relatively adult neoplasms, previously labeled ganglioneuroblastoma) Calcification was absent in grade 4 lesions.

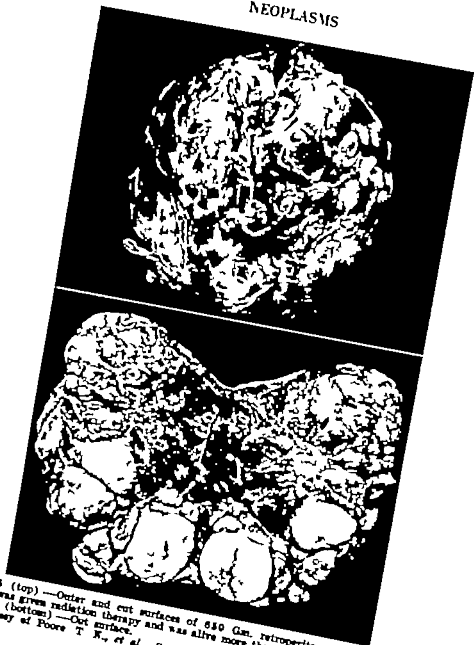


Fig. 5 (top).—Outer and cut surfaces of 650 Gm. retroperitoneal neuroblastoma. Patient was given radiation therapy and was alive more than nine years after operation.
Fig. 6 (bottom).—Cut surface.
(Courtesy of Poore, T. E., et al.: S. Clin. North America 31:1121-1141, August, 1951.)

Mitotic figures were found in all but one lesion, a grade 2 tumor.

The preferred treatment is surgical extirpation by posterolateral approach, followed by irradiation of the tumor site and metastases. Despite encapsulation there may be a tendency to extensive and persistent hemorrhage. There were no surgical deaths but three patients died within two

weeks of exploration Of 18 patients who could be traced, 16 were dead (after an average of 3 8 months) Two had survived 9 years and 10 months In the former it was necessary to divide the vena cava to remove the tumor (grade 3 neuroblastoma), metastasis to lymph nodes having occurred X ray therapy was given before and after operation From the latter a grade 2 neuroblastoma was removed but apparent metastasis remained, x ray therapy was given. Twenty four cases of survival of two or more years have been reported

Because of the number of increasing reported survivals, it is believed that early recognition, prompt radical surgical procedures and large amounts of radiation given in small divided doses constitute the best method of dealing with these tumors

Surgical Treatment of Lymph Node Metastases Grantley W Taylor[3] (Harvard Med School) emphasizes that failures in cancer treatment are often attributable to regional recurrence rather than to widespread generalization of the disease and that more radical eradication of regional lymph node drainage areas might prevent recurrence Lymph node metastases arise through loss of adhesiveness and ameboid motility of cancer cells The current concept is one of lymphatic embolism from the primary focus to the regional lymph nodes draining the area As the normal pathway becomes blocked through obstruction at the involved node, collateral pathways become involved with secondary metastases in other nodes Critical review and scrutiny of the anatomy of the lymphatic drainage areas have led to many corrections in formal anatomic texts emphasizing the high incidence of occult microscopic metastasis of cancer

Aggressive therapy consists of thorough carefully planned radical dissection of the lymph node area as part of one stage en bloc procedure or as a separate procedure after eradication of primary carcinoma X ray treatment of lymph node metastases is reserved for situations where proper block dissections are not feasible where control of the primary lesion is doubtful, in such tumors as are particularly sensitive to radiation and when involvement is too extensive to permit surgical eradication

(3) New England J Med 245 608-618 Oct 18 1951

Lymph node metastases in skin carcinomas are so rare that regional node dissection may be omitted unless metastasis is obvious. When dissection is omitted, the patient must be watched for many years, with prompt dissection if metastases develop

Regional lymph node dissection is indicated in all controllable cutaneous malignant melanomas because of the high incidence of lymph node metastasis When the primary lesion is so situated that regional lymphatic drainage is uncertain or overlaps (as in the trunk or shoulder) it may be justifiable to defer dissection until metastases appear

For breast cancer radical mastectomy offers the best prognosis for patients with regional node metastases Some surgeons have advocated supraclavicular dissection and anteromediastinal exploration

In mouth cancer the trend is toward more radical procedures, with many more one stage en bloc procedures, combining neck dissection with jaw resection and the necessary intraoral surgery Opinion differs on incidence of metastases in lip cancer Primary prophylactic dissection when no metastases are obvious is rarely recommended if active supervision for a number of years is feasible Dissections for involved nodes, even when less extreme than complete radical neck dissection yield a high percentage of cures Cervical node metastases occur frequently in cancer of the tongue and prophylactic dissections are advocated Metastases in laryngeal cancer are infrequent the patient should be watched so that radical dissection can be done if metastases appear Incidence of cervical node metastases in parotid cancer warrants radical neck dissection. It is also advocated in carcinoma of the thyroid gland. If carefully done bilateral neck dissection with ligation of both internal jugular veins is safe

Surgeons are now studying the detailed surgical anatomy of regional lymph nodes in carcinoma of the lung and esophagus to develop more radical procedures

More radical surgery with more lymph node dissection for carcinoma of the stomach and large bowel has been advocated

Cervical carcinoma remains localized in the primary site and regional lymph nodes for a long time and may be re

moved by sufficiently radical surgery Further study to establish the frequency of intrapelvic lymph node spread in vulval carcinoma is needed. Radical surgery and radium therapy have been advocated.

Many advocate retroperitoneal lymph node dissection for carcinoma of the testes. End result studies will have to be obtained before radical surgery for carcinoma of the bladder can be evaluated

Role of Pelvic Evisceration in Surgery Eugene M. Bricker and John Modlin[4] (Washington Univ) believe that pelvic



Fig. 7 —Sites for subsequent ileostomy and colostomy are first marked on the abdomen (insert) If the lesion is operable the sigmoid and its mesentery are sectioned. The peritoneum is incised from the bifurcation of the aorta to the inguinal ligament and the incision is curved medially over the symphysis pubis. (Courtesy of Bricker E. M. and Modlin, J Surgery 30 76-94 July 1951)

evisceration may have a definite role in treatment of advanced pelvic cancer especially in cervical carcinoma recurring after irradiation therapy Patients must be care

(4) Surgery 30 76-94 July 1951

fully selected and the surgery must be technically meticulous Over all operative mortality among 32 patients was 34% but in the most recent 22 cases was 23% Of 15 patients with postradiation cervical carcinoma, carcinoma of the uterus and carcinoma of the vagina, 9 have been relieved of pain and discomfort Five died during surgery and one subsequently died of cancer

Carcinomas of the prostate and bladder have remote me

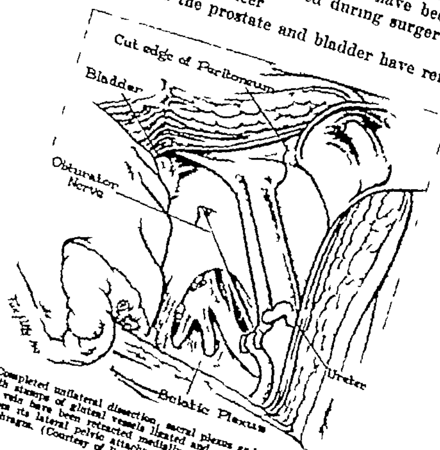


Fig 8 —Completed unilateral dissection, sacral plexus and sciatic nerve are clearly visualized with stumps of gluteal vessels ligated and cut. The hypogastric artery and internal iliac vein have been retracted medially the entire uterosacral ligament has been freed from its lateral pelvic attachments. Dissection has been carried down to the pelvic diaphragm. (Courtesy of Bricker E. M. and Modlin, J: Surgery 30 76-94 July 1951)

tastases which rule out treatment by this operation Carcinoma of the vagina should be considered in the same light as carcinoma of the cervix, with irradiation the primary treatment The late and local metastatic spread of carcinoma of the uterus and cervix makes this operation suitable for recurrent disease In patients with radionecrosis following irradiation for cervical cancer pelvic evisceration may be beneficial even though persistent tumor is not demonstrated

The local spread of carcinoma of the rectum and rectosigmoid makes pelvic evisceration suitable

For recurrent carcinoma of the cervix resection in the lateral planes should be as wide as possible The patient's

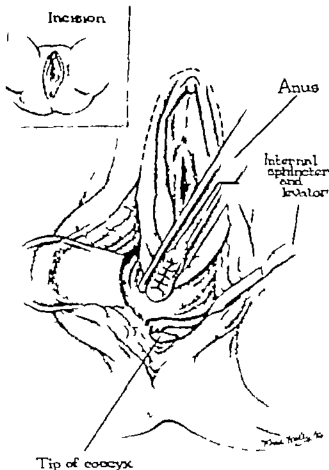


Fig 9—The perineal portion of the operation is similar t that of abdominoperineal resection f the rectum except that anterior pelvic viscera are included. The incision circumscribes the labia minora and clitoris. The pelvic diaphragm is sectioned as fa laterally as possible (Courtesy of Bricker E. M., and Modlin, J Surgery 30 76-04 J ly 1951)

general condition should be good, she should be under 60 and distant metastases should be ruled out.

TECHNIC—After careful bowel preparation and endotracheal gas-oxygen-ether or spinal anesthesia a long midline incision is made down to the symphysis. Careful search is made for regional and distant metastases and resectability of the lesion is determined. Other than extensive metastases to iliac and hypogastric lymph nodes, the factor most likely to make resection inadvisable is lateral

extension of the primary tumor Regional lymph node involvement does not contraindicate resection if there is no extensive direct lymphatic permeation and if there is no involvement of the para aortic lymph nodes If resection is possible the sigmoid colon is sectioned and the proximal end brought out through an accessory incision at the left lower quadrant (Fig. 7) and the distal end of the cut colon closed with an inverting catgut suture The lateral lumbar gutter is carefully closed The mesentery of the sigmoid

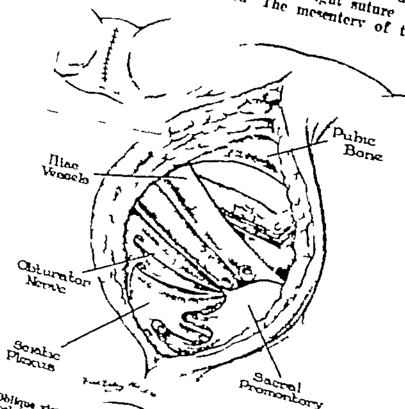


Fig 10.—Oblique view int pelvis after removal of specimen. Obviously a peritoneal floor for the pelvis cannot be re-formed. The perineal opening is closed by layers of interrupted, nonabsorbable suture closing the subcutaneous fat and skin. A drain is brought out through the dependent angle of the wound. (Courtesy of Bricker E. M. and Modlin J Surgery 30 0-94 July 1951)

colon is sectioned down to the superior hemorrhoidal vessels which are cut and ligated at the level of the bifurcation of the aorta. Dissection is carried over the promontory of the sacrum and the rectum freed from the curve of the sacrum. The peritoneum is incised from the bifurcation of the aorta along each iliac artery to the femoral canal. The ovarian vessels are clamped, cut and ligated. The ureters are dissected 3-4 cm. below the level at which they cross the iliac arteries and are sectioned the proximal end is ligated to dilate the ureter and facilitate ureterointestinal anastomoses. The peritoneal incisions are extended medially from the region of the

femoral ring over the lower portion of the anterior abdominal wall to meet over the symphysis pubis, the bladder is separated from the symphysis.

The lymph nodes, connective tissue and fat are completely dissected along the entire length of the common and external iliac arteries and down to the iliac vein The obturator fossa is emptied of all lymphatics and the vessels are carefully sectioned The hypo-

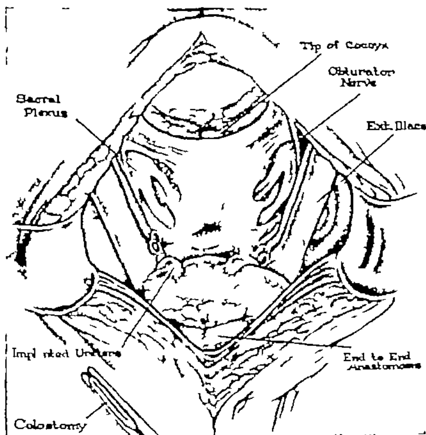


Fig. 11 —Completed dissection with ureters transplanted to isolated segment of terminal ileum. Abdominal portion of the wound is closed with interrupted figure-of eight steel wire sutures. The peritoneum of the lower part f the abdominal wound is usually removed and no ttempt is made to reperitonize this area. (Courtesy of Bricker E. M., and Modlin J Surgery 30 76-94 J ly 1951.)

gastric artery internal iliac vein and gluteal branches are sectioned The complete lateral attachments of the cardinal ligaments and parametrium are freed from the lateral pelvic wall and the sacral plexus and sciatic nerve are cleanly dissected into view (Fig 8) Great care must be exercised not to injure the sacral plexus The entire specimen (bladder vagina, cervix, uterus and rectum) is then completely free from the lateral pelvic wall from the midline of the sacrum to the symphysis pubis and extending down to the levator sling The same procedure is done on the opposite side.

The ureters are anastomosed to an isolated segment of distal

ileum and the continuity of ileum is re-established by end-to-end anastomosis. An end-to-side anastomosis mucosa-to-mucosa, of ureter to isolated segment of terminal ileum follows and the distal end of this segment is brought out through the accessory incision in the right lower quadrant.

The patient's legs are then placed in stirrups and an incision made around the anus and including the labia minora and clitoris (Fig 9) The posterior part of the dissection is done in the same way as in abdominoperineal rectal resection. The fascia propria is cut and the levator muscles are sectioned widely at their attachment to the lateral pelvic fascia. The anterior pelvic diaphragm is sectioned along its lateral attachments and the entire specimen is removed (Fig 10) The small intestine and omentum are then drawn down into the pelvis and both abdominal and perineal wounds are closed (Fig 11) Both the ileostomy and colostomy are opened and the mucosa is sutured to the skin with interrupted catgut A urethral catheter is inserted into the ileum segment for drainage.

The procedure for carcinoma of the rectum differs since the bladder can often be saved and extreme lateral dissection is omitted.

Postoperatively the patient is placed on continuous duodenal suction, a Rutzen type bag is applied to the ileostomy as soon as possible and antibiotics are given Intravenous pyelograms are made before the patient leaves the hospital

Radioactive Cobalt as Adjunct to Cancer Surgery Arthur G James, Roger D Williams and Joseph L Morton[5] (Ohio State Univ) have found radioactive cobalt an adequate safe and inexpensive radiation agent. It has several advantages over radium (1) Penetrating beta rays are completely filtered more easily and tissue near bone can be irradiated more safely than with radium (2) Cobalt can be used in multiple weak sources in which accurate dosage control allows heavy treatment close to previously irradiated tissues (3) The thin, flexible Nylon applicator encasing the cobalt can be used in an irregular mass of tumor tissue and can be patterned for a uniform and yet an effective level of radiation to the entire tumor (4) The cost of cobalt is below that of radium. (5) It is simply calibrated by means of electroscope (6) Since it is magnetic it can be more easily handled with use of a small electromagnet. (7) It is safer since it forms no gaseous radioactive products on decay and there is no powder to become absorbed in case of breakage

Co_{60} is cut in small lengths of about 3 mm. and encased in flexible Nylon tubing The loaded Nylon applicators may

(5) Surgery 30 95 104 July 1951

be implanted into any site which can be reached by long, straight Keith or curved tension needles or by straight or grooved pointed guides used like aneurysm needles (Figs 12 and 13)

Radioactive cobalt has been implanted in 53 patients including 38 with disease of the head and neck 8 of the abdomen, 4 of the chest and 3 of the extremities Histologic

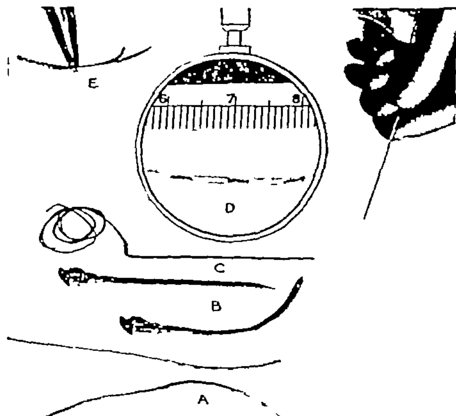


Fig 12 —Types of Co^{60} applicators and guide needles. *A*, flexible Nylon tubes *B* curved and straight grooved guide needles *C* rigid aluminum needle containing Co^{60} *D* Nylon tube magnified (darker segments represent 3 mm. lengths of Co^{60}) *E*, curved guide needle. (Courtesy of James, A. G *et al.* Surgery 30 95-105 July 1951)

diagnosis showed 37 instances of squamous cell carcinoma 8 of adenocarcinoma 4 of sarcoma, 3 of lymphosarcoma and 1 of basal cell carcinoma

Radioactive cobalt is useful in head and neck tumors because it can be better applied to irregular masses of tumor tissue it can be used for treatment of inoperable malignant tumors it can be used more safely near bone or large vessels and it can be used effectively in some areas which have

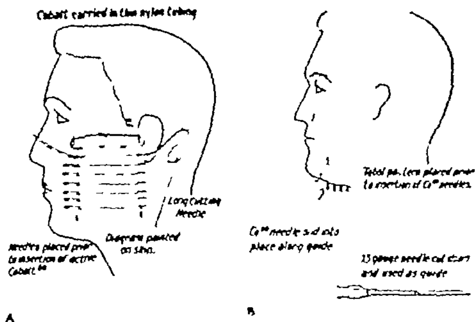


Fig. 13.—Inserted cobalt applicators. *A*, implantation technic, flexible Nylon threads. *B*, rigid needle technic; note that the pattern is obtained with empty guide needles 1 cm. apart before Co^{60} applicators are pulled into place. (Courtesy of James, A. G., *et al.*: Surgery 30:95-105, July 1951.)

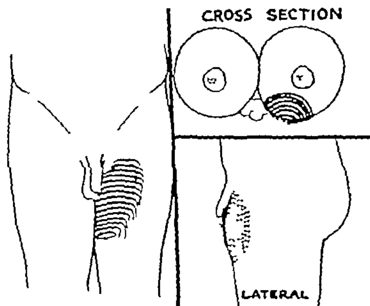


Fig. 14.—Upper thigh with Co^{60} implanted into recurrent neurogenic fibrosarcoma. Note uniform pattern of implantation. (Courtesy of James, A. G., *et al.*: Surgery 30:95-105, July 1951.)

previously been heavily treated with external radiation to the point of skin tolerance. It is used for heavy irradiation to deeply seated residual malignant tumors of the abdomen

and thorax Radioactive cobalt was placed near tumor tissue surrounding the carotid artery in a woman who had excision of the mouth lesion and radical neck dissection for squamous cell carcinoma of the gingiva It has been used for recurrent carcinoma of the gingiva and basal cell carcinoma of the orbit

Radioactive cobalt is effective in metastatic adenocarcinoma in the retroperitoneal lymph nodes which are adherent to the major vessels (Fig 15) It has been used in the chest for carcinoma of the esophagus and metastatic carcinoma of the lungs and was directly implanted into a tumor in the inguinal area in a man with neurogenic fibrosarcoma (Fig 14) Long term observations will be required to determine its efficacy in otherwise hopeless cases.

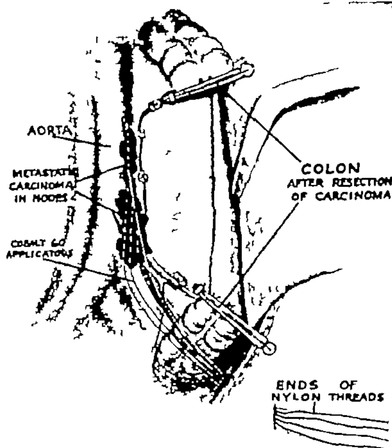


Fig 15 —Co^{60} Nylon applicators in place in metastatic adenocarcinoma in aortic lymph nodes from sigmoid cancer Loose ends brought out through abdominal wall stab wound. (Courtesy J James, A. G., *et al* Surgery 30 95 105 July 1951)

Treatment of Intracranial Aneurysms. James L. Poppen[4] (Lahey Clinic) points out that intracranial aneurysms are found more frequently than formerly because of the use of arteriography. Many patients can be saved by surgery, either by direct intracranial attack or by the indirect method of ligating the internal carotid artery in the neck. The surgeon must know the hazards of surgical treatment of intracranial aneurysms at specific sites.

The aneurysms occur at any age but are commonest between 20 and 50, are more frequent in females than in males and are more frequent on the left than on the right side. The initial symptom is usually a subarachnoid hemorrhage; 35% of these patients die during the initial episode and 50% have a second hemorrhage within a month. Treatment should be directed to avoiding the second hemorrhage.

The aneurysms occur in the anterior two thirds of the circle of Willis in 75% of cases and in the lower region in 25% (Fig 16). Treatment must be based on the adequacy of the collateral circulation of the circle of Willis. Anomalies of the circle include atresia of the left or of both posterior communicating arteries, complete absence of one posterior communicating artery or of one and atresia of the other and complete absence of both arteries. The only way definitely to diagnose an aneurysm before death is by direct exploration or by arteriography. If an aneurysm is found on the suspected side arteriography should be done on the other side to determine if the collateral circulation is adequate and if another aneurysm is present. Multiple aneurysms were found in 8% of 161 cases. Arteriography should be performed by the percutaneous closed method.

Conservative treatment is rarely justified. It is indicated for bilateral multiple aneurysms, arteriosclerotic saccular aneurysms that do not cause disturbing local symptoms and large aneurysms having communications with a few of the larger cerebral veins. Surgical treatment should not be used when collateral circulation is inadequate.

(4) Postgrad. Med. 10:380-387, November 1951.

Principal surgical procedures are diagnostic burr openings, usually in the superior temporal region, subtemporal decompression for removal of large extradural or subdural hematomas, and elevation of depressed skull fractures, simple or compound.

Meredith prefers to wait two or three days before repairing simple depressed skull fractures provided there are no signs of localized cerebral compression With compound depressed skull fracture, operation is done immediately if the patient's general condition permits and he is not in shock, this is done to prevent infection Compound linear fractures of the skull require no surgery except suture of the overlying scalp laceration, unless infected material has been caught in the bone fracture line, in which case the immediate fracture line is excised with rongeurs. Fractures of the skull base have no surgical importance they are diagnosed by escape of cerebrospinal fluid or cranial nerve signs. In simple depressed fractures of the vault, it is best to replace the bone in the form of a mosaic over the intact or sutured dura to avoid later need of a tantalum plate. In compound depressed fractures the bone fragments are removed and a tantalum plate is inserted to prevent infection.

Post-traumatic cerebrospinal fluid otorrhea almost never requires surgery usually closing spontaneously Active leak of fluid through the nose occasionally requires closure of the fistula. It is usually in the region of the cribriform plate of the ethmoids or through the posterior wall of the frontal sinus, and the stoma is best closed with muscle through the intradural route

The most important point about wounds due to metallic missiles is that débridement and thorough irrigation with large quantities of warm saline of the wound of entrance and exit are more important than removal of the missile itself, particularly if this would require a fresh cerebral incision through important functional areas of the brain. Retained bone fragments should always be removed to prevent post traumatic cerebral abscess.

Patients with cerebral edema may need subtemporal decompression. Diagnostic burr holes are occasionally necessary to differentiate cerebral contusion from hematomas.

The important complications of acute head injury are

tions for later surgery, according to Learmonth, include previous long-continued sepsis, when the nerve lies at the bottom of a healed "trough" wound, when there has been severe bleeding with the possibility of muscle necrosis and later strangulation of the nerve, in closed crushing injuries, when a main artery has been divided at the same level, when two or more nerves are divided at the same level and when persistent pain or hyperhidrosis is present (5) resection of the nerve can be undertaken and sutures placed in later operations if there is doubt concerning the nerve, and (6) nerve grafting using an autogenous cutaneous nerve can be used.

Causalgia which occasionally occurs after nerve injuries can be treated by sympathectomy which was successful in four patients with causalgia after injury to the digits.

A preganglionic sympathectomy is helpful in patients with persistent cold sensitivity of the limb after a combined arterial and nerve injury

Treatment of Intractable Pain of Visceral Origin I Ridgeway Trimble and Samuel Morrison[9] (Univ of Maryland) report that 12 patients with severe thoracic, abdominal or pelvic pain due to advanced malignant disease were greatly relieved after interruption of the involved sympathetic nerve paths by alcohol block or surgery Whether such relief is due to interruption of the viscerosensory reflexes, as described by Mackenzie in his concept of referred pain, to interruption of true visceral pain fibers arising in the viscera, the pain being transmitted over the autonomic paths, or to interruption of both paths is not entirely known. The patients included six with carcinoma of the pancreas, five of whom had metastases, and one each with hypernephroma and carcinoma of the bladder, sigmoid, liver and rectum, all of whom had metastases

It has been shown that infiltration of the sympathetic trunk at the 7th, 8th and 9th thoracic levels causes the whole stomach and duodenum to become insensitive Infiltration at the 8th, 9th and 10th thoracic levels affects the gall bladder at the 12th thoracic and 1st lumbar levels; the kidneys, and at the 1st and 2d lumbar levels, the bladder

In every case of advanced carcinoma with severe pain in

(9) J A M A 148 1184 1188 Apr 5 1952

which the usual narcotics are no longer effective, efforts should be made to determine the sympathetic nerve paths involved and the most expeditious and least harmful manner in which to carry out appropriate sympathetic denervations

[Lobotomy also is a very useful procedure in cases of intractable pain due to advanced cancer.—Ed.]

FACE, BUCCAL CAVITY AND NECK

Management of Head and Neck Cancer by General Surgeon In caring for patients with head and neck cancer division of responsibility is great. Lack of wide experience by any one person is due partly to the relative infrequency of these tumors plus a demand for a variety of skills at present considered the responsibility of several medical subspecialties A knowledge of the natural history of tumors in this area together with some endoscopic ability, familiarity with indications and contraindications for radiation therapy and a good basic general surgical training are required for optimal care of these patients H. Mason Morfit[1] (Univ of Colorado) believes that at present general surgical training places the physician in the best position to handle these problems

Head and neck tumors usually metastasize to the regional lymphatics Even though a patient may die of uncontrolled disease only a minority will show distant dissemination at autopsy Radical surgical attack designed to remove both the primary focus and regional cervical lymph nodes will eradicate the disease in many patients

TECHNIC—Generous sedation is given preoperatively and a tracheostomy is the first operative step. Radical neck dissection is done but the neck contents are left attached to the mandible. The lower lip is split in the midline and entire cheek flap reflected laterally The outer surface of the mandible is exposed by dividing the insertions of the masseter muscle at the jaw angle. The jaw is then divided with a Gigli saw at the selected point and reflected laterally It is then possible to cut around the margins of the primary tumor under direct vision. The primary tumor is removed in continuity with the neck contents. To complete disarticulation of the mandible, the pterygoid muscles are cut, leaving the stumps for use in closing

(1) A.M.A. Arch. Surg. 64 631-646 May 1952.

the defect The jaw is pulled downward bringing into view the attachment of the temporal muscle to the coronoid process. This is severed, the temporomandibular fossa slit and the jaw twisted and pulled free of its final attachments.

After resection a large wound is present, extending from the clavicle to the maxilla. Closure is begun at the posterior intraoral aspect mucosa being sutured to mucosa whenever possible. If part of the tongue was removed, the cut edge of the lateral border is sutured directly to mucosa of the corresponding cheek. Interrupted 000 chromic sutures are placed at intervals not exceeding 6-7 mm. The primary mucosal suture line is buttressed by pulling underlying soft tissues together to eliminate dead space beneath it. Stumps of muscles may be used for this purpose Mucosal sutures are continued to the midline anteriorly and then extended up on the inner surface of the lower lip Musculature of the lower lip and chin tissues is approximated with absorbable surgical gut sutures, as is the platysma or other tissue contained in the skin flaps. Skin closure is with interrupted 0000 nonabsorbable surgical silk sutures. Two large Penrose drains are placed beneath the skin flaps, one into the submaxillary triangle and the other into the temporomandibular fossa, and both are brought out through the end of the wound near the clavicle The tracheostomy tube is firmly anchored in place. A large bulky dressing is applied so as to assure a good airway around *the tracheostomy stoma.*

Postoperatively the most probable cause of death is respiratory obstruction therefore patency of the tracheostomy tube is necessary at all times. Patients are fed through a nasogastric tube for eight days and then small amounts of food can be given by mouth.

Incidence of Distant Metastases among Patients Dying with Head and Neck Cancers. Leonard F Peltier Louis B Thomas, T H Crawford Barclay and Arnold J Kremen[3] (Univ of Minnesota) analyzed the autopsy records of 200 patients with head and neck cancers and found metastases below the clavicle in 34 (17%) The location of the primary tumors in these 34 patients were lower lip tongue, buccal mucosa, alveolar ridge, tonsillar fossa, palate nasal cavity nasopharynx, maxillary sinus pharynx, parotid and lacrimal gland Of the 187 men and 13 women in the series, 120 died of respiratory complications, 53 of complications associated with tumor growth and 27 of unrelated causes.

Of the patients with distant metastases, 28 had cervical lymph node involvement This high incidence may be a reflection of either the advanced stage of disease at which

(3) Surgery 30 827-833 November 1951

distant metastases occur or the greater malignant potential of the tumors which metastasize Once the tumor cells leave the neck they become widely disseminated There were 8 metastases to thoracic and 5 to abdominal lymph nodes, 21 to the lung, 16 to the liver, 8 to the heart, 7 to the adrenal gland, 5 to bones, 4 to the kidneys and 2 each to the pancreas and spleen. Thirty-one of the metastasizing tumors were squamous cell carcinoma 2 were cylindromas and 1 was an adenocarcinoma of the parotid.

In view of the fact that even at the time of death 83% of the patients with cancer of the head and neck still had the disease confined to the relatively local area above the clavicle, surgeons should make all efforts to eradicate cancer in this area.

Cancer of Tongue. David Lyall and Charles F Schetlin[3] (New York Univ) analyze 76 consecutive cases of tongue carcinoma and conclude that bilateral complete cervical

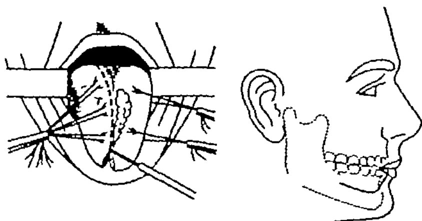


Fig. 17 (left) —Line of excision of primary carcinoma of tongue emphasizing wide margin of uninvolved tissue.

Fig. 18 (right) —Incision through lower lip and cheek to give access to lesions of posterior third of tongue.

(Courtesy of Lyall, D., and Schetlin, C. F Ann. Surg. 135:489-496 April, 1952.)

node dissection in two stages is the treatment of choice whether clinical evidence shows node involvement or not. The primary tumor must be under control by surgical excision or some form of radiation therapy before neck dissection is attempted. Clinical estimates of node involvement are grossly inaccurate An experienced pathologist can

(3) Ann. Surg. 135:489-496, April, 1952.

evaluate adequacy of excision by examining the primary tumor specimen If inadequate, prompt node dissection can be arranged in two to three weeks Diathermy knife is the best tool for excising the primary lesion (Figs. 17 and 18)

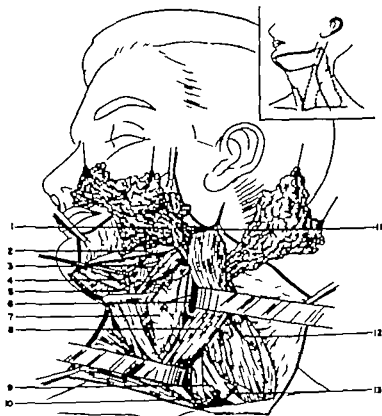


Fig 19 —Finish of standard unilateral complete neck dissection without removal of sternocleidomastoid muscle or internal jugular vein; dissection of jugulodigastric and upper posterocervical regions not adequately shown. Shaded area (*inset*) shows extent of undermining of skin flaps. *1* ligated upper and external maxillary artery and anterior facial vein *2* ligated lower stump external maxillary artery, *3* lingual nerve; *4* ligated submaxillary duct *5*, hypoglossal nerve; *6* jugular vein and descendens hypoglossal nerve; *7* areolar tissue and fat pad at side of larynx; *8* sternocleidomastoid muscle *9* ligated external jugular vein *10* thoracic duct; *11* cut end lower pole of parotid gland, *12* spinal accessory nerve and *13* transverse scapular vein. Platysma muscle remains on inferior medial skin flap, but not on other flaps. (Courtesy of Lyall, D and Schetlin, C. F Ann. Surg 136 489-496 April, 1952)

In patients without clinical involvement and those with isolated, freely movable metastases, the choice is a Semken type neck dissection without removal of the sternocleidomastoid muscle and internal jugular vein. If these structures are involved they are sacrificed as in the Crile type of neck dissection. If the spinal accessory nerve must be sacrificed the

denervated sternocleidomastoid muscle is removed (Fig 19)

Irradiation is far inferior to surgery for operable neck metastases but is valuable in inoperable cases

Of the series, 66 patients had surgery of the primary lesion 7 were classed as inoperable and had palliative irradiation 2 were treated by insertion of radon seeds and 40 had node dissection Histologic examination showed 50% error in clinical estimate of node involvement With no evidence of recurrence, 29 patients survived at least five years —an absolute five year arrest rate of 38.1% Of four post operative deaths, three followed node dissection (5% mortality) One death after primary tumor excision gave 1.5% mortality for glossectomy Combined operative mortality was 6%

Cancer of Tongue Surgical Technic for Primary Combined en Bloc Resection of Tongue, Floor of Mouth and Cervical Lymphatics Arnold J Kremen[4] (Univ of Minnesota) performed this operation on 12 patients, 2 of whom died of recurrent cancer in the neck without local recurrence 10 and 11 months after surgery Both had extensive primary lesions and involved lymph nodes.





Fig. 20 —Transection of mandible with Gigli saw outline of mucosal incision in the mouth and hemisection of tongue and floor of mouth (Courtesy of Kremer A J Surgery 30 227 240 July 1951)

(4) Surgery 30 2 7 240 July 1951

TECHNIC.—A tracheotomy and Witzel gastrostomy are performed five to seven days preoperatively to provide an adequate airway during and after operation and allow for easy and adequate feeding. The incision begins over the medial end of the clavicle and is extended obliquely upward over the anterior edge of the sterno-

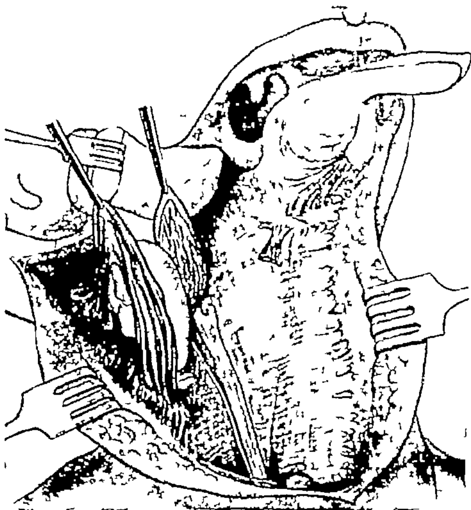


Fig 21.—Completion of intraoral and submaxillary dissection with resected tongue segment and floor of mouth dissected down to join neck dissection. The digastric muscle, hypoglossal nerve, external carotid artery and entire upper deep cervical glands are sacrificed. (Courtesy of Kremen, A. J. Surgery 30 227-240, July 1951.)

cleidomastoid muscle to the mastoid process, then transversely beneath the mandible to the opposite submandibular area. A vertical extension carried upward in the midline bisects the lower lip. After wide reflection of medial and lateral skin flaps to include the platysma muscle, dissection is started at the lowermost part of the neck cutting the sternocleidomastoid muscle from its sternoclavicular at

tachment and ligating and cutting the jugular vein at the level of the clavicle. The supraclavicular fossa is dissected free down to the prevertebral fascia and the carotid artery is dissected from its sheath and adventitia, preserving the vagus nerve. Dissection is carried up to the bifurcation of the carotid artery, at which juncture the external carotid artery is ligated.

The lower lip is transected in the midline and the underlying mandible cut with a Gigli saw in the same plane (Fig 20) The

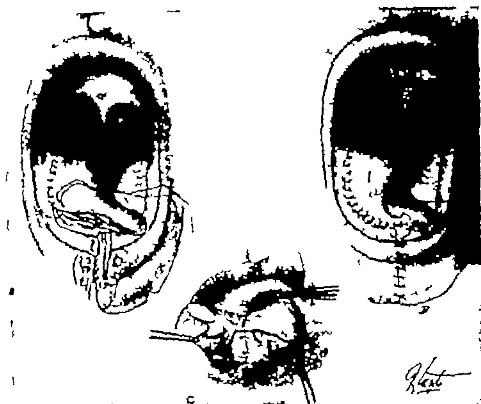


Fig. 22.—Reconstruction of oral cavity *A* the dorsal mucosal edge of the tongue is sutured to the mucosa along the alveolar ridge after swinging the mandible to normal position. *B* anteriorly the under side of the tongue and mucosa of residual floor of the mouth are approximated mucosa of the raw edge of the short remaining anterior tip of the tongue is approximated and the lip sutured in its normal position. *C* two stainless steel wires approximating the severed mandible. (Courtesy of Kremen A. J : Surgery 30:227 240 July 1951)

intraoral mucosal incision is developed along the inner aspect of the lower alveolar ridge back to the anterior pillar In developing the mucosal incision, a 5-6 mm. flap of mucosa must be preserved along the inner aspect of the alveolar ridge for suture of residual mucosa in reconstructing the oral cavity The periosteum of the inner aspect of the mandible is then stripped away along with the attachments of the genioglossus, hyoglossus and digastric muscles. This allows lateral retraction of the mandible for excellent exposure. The tongue is divided down the midline as far posteriorly as neces-

sary The incision is then curved lateralward to connect with the alveolar ridge incision, including the tonsillar pillar and portions of the soft palate, if indicated The mucosa, tongue and floor of mouth are then dissected downward, removing all the contents and muscles of the submaxillary triangle down to the neck dissection area (Fig 21) The upper portion of the cervical neck dissection is completed by ligating the jugular vein at the level of the styloid process, cutting the sternocleidomastoid muscle from its mastoid attachment, sacrificing the external carotid artery and taking the digastric and stylohyoid muscle A contralateral conventional submaxillary gland dissection is performed

The oral cavity is reconstructed (Fig 22) by mobilizing the residual tongue and suturing the cut edge of its dorsal mucosa to the alveolar ridge until the midline is approached, then bringing mucosa from the under surface of the tongue and residual floor of the mouth to approximate this area The mandible is brought back to normal position and fixed with two stainless steel wires placed through drill holes. The lip is sutured and the neck incision closed.

No oral feedings are given for seven days postoperatively In two to four weeks gastrostomy feedings can be discontinued. After six to eight weeks the patient can speak without difficulty

Removal of regional lymph bearing tissue is an essential part of management of operable tongue cancer because of the high incidence of histologically involved nodes

Application of Combined Hemimandibulectomy and Neck Dissection to Oral Carcinoma Walter W Carroll[5] (Northwestern Univ) reviews experience with 186 intraoral cancer patients Great clinicopathologic similarity exists among cancers arising from the lower gingiva, buccal mucosa near the lower gingiva, nearby floor of the mouth and anterolateral two thirds of tongue These constitute approximately 40% of all oral cancers Each produces a high incidence of early lymph node metastases, so located that both primary and secondary lesions can be excised in continuity The operation of choice is en bloc dissection of related deep jugular lymphatics with hemimandibulectomy to complete or facilitate excision of the primary lesion Of 106 patients with lesions thus localized 46 had radical neck dissection with or without excision of the primary tumor in continuity Cure rate of discontinuous therapy (irradiation of primary cancer and delayed neck dissection for metastases) was not impressive and local recurrence was common

(5) A M A Arch Surg 64 647-654 Ma 1952

Lower gingival cancer, formerly was considered relatively benign with tendencies of buccal mucosa carcinoma rather than of growths arising from the tongue, but tendency to cervical lymph node metastases has been reported as high as 65% Local contiguous spread from primary growth is common and osteoradionecrosis from previous therapy may compound the problem Radical neck dissection combined with hemimandibulectomy in continuity will increase rate of salvage from this neoplasm

Carcinoma of the floor of the mouth and the lateral two thirds of the tongue should be considered a single entity because of similarity in embryologic and anatomic relationships tumor pathogenesis and response to treatment Squamous cell carcinomas of these areas metastasize freely to regional lymph nodes Treatment of choice for moderately advanced lesions has been radiotherapy followed by ipsilateral radical neck dissection after control of the primary tumor Whether irradiation, external or interstitial or some combination of the two can completely sterilize the primary lesion is questionable

Data suggest that wide excision of the primary lesion after irradiation might increase over all cure rate Most intraoral carcinomas metastasize into ipsilateral jugular nodes but in 50% of normal persons lymphatics of the tongue and floor of the mouth pass through the mandibular periosteum as they drain into the submaxillary or subdigastric nodes Such cancers when near the mandible are best eradicated by hemimandibulectomy added to excision of primary lesion and nodes in continuity So imposing an operation produces good results in postirradiation recurrence or extensive primary involvement, and patients with less extensive cancer undoubtedly would benefit even more If the lesion approaches the midline, simultaneous contralateral submaxillary dissection in continuity should be added because of increased risk of cross metastases. Nodes involved on the opposite side require complete deep jugular dissection later

For many such patients hemimandibulectomy is an essential part of surgery but for others it must be added to diminish possibility of local recurrence or to eliminate persistent pain of previously established osteoradionecrosis

Patients thus treated did well. It is too early to report long term survival rates, but much morbidity has been eliminated. Patients were rehabilitated rather quickly and early recurrences were not noted

Operative Removal of Tumors of Parotid Salivary Gland. According to Hayes Martin[6] (Memorial Hosp., New York

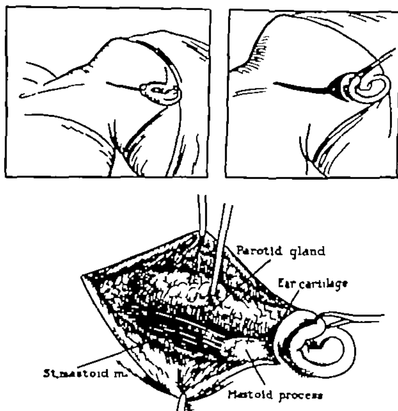


Fig. 23 (top) —Y-shaped incision for removal of tumor of parotid salivary gland.
Fig 24 (bottom) —Dissection of skin flaps.
(Courtesy of Martin, H.: Surgery 31:670-682, May 1952.)

City) the two cardinal principles in surgery of parotid gland tumors are (1) complete removal of the growth and (2) avoidance of injury to the seventh nerve. Risk of injury to this nerve acts as a deterrent to adequate exposure in many operations with the result that growths are often incompletely removed. The best method of avoiding such injury is routine exposure and identification of the nerve first, before proceeding with actual removal of the tumor

(6) Surgery 31 670-682 May 1952

The nerve can be most safely and readily exposed proximally as it emerges from the stylomastoid foramen

TECHNIC.—A satisfactory incision for adequate exposure of all parts of the parotid gland is the Y incision shown in Figure 23 An anterior extension may be used for the more extensive tumors. In dissecting back the skin flaps, the cleavage plane should be along the capsule of the parotid gland, which is thin and somewhat difficult to follow, especially in a highly vascular field. The anterior or cheek flap is dissected forward, exposing the central portion of the gland (Fig 24) The posterior flap is dissected backward toward the mastoid bone and adjacent sternocleidomastoid muscle exposing the tail of the gland. By dissecting the lobule of the ear and the

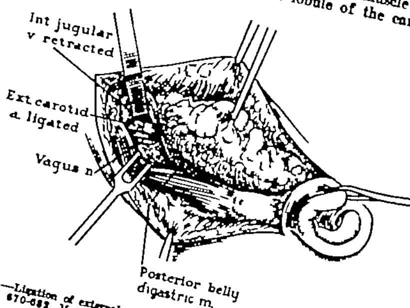


Fig. 25 —Ligation of external carotid artery (optional) (Courtesy of Martin, H. Surgery 31 670-682 May 1952)

posterior wall of the cartilaginous external auditory canal upward, the upper limits of the gland are reached.

After the skin flaps have been developed, ligation of the external carotid artery is readily done, if desired through the lower end of the incision (Fig 25) This procedure is sometimes indicated for bulky highly vascular tumors. The scarring it produces is objectionable in case neck dissection is required later If the main trunk of the seventh nerve is exposed in all cases, the chance of inadvertent injury to this vital structure is practically nil. It is exposed at a depth of about 1.5 cm. from the external surface of the mastoid process by dissecting directly downward along the anterior border of the mastoid process above the attachment of the posterior belly of the digastric muscle (Fig 26) The exposure is made by blunt dissection along the posterior capsule of the parotid, pushing the

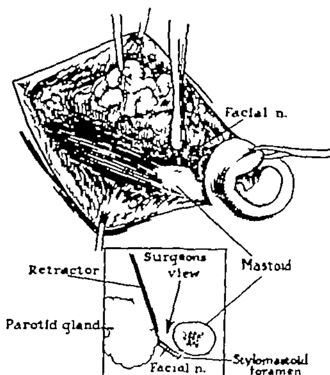


Fig 6 —Exposure of main trunk of facial nerve. (Courtesy of Martin, H.: Surgery 31:670-682 May 1952)

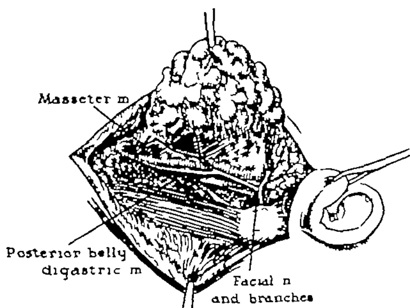


Fig. 27 —Parotid gland separated and pushed forward, exposing and preserving all branches of nerve (Courtesy of Martin, H. Surgery 31 670-682 May 1952.)

gland anteriorly The main trunk when first seen is between 3 and 4 mm. in diameter and is readily identified. Once it is identified, the parotid gland and any tumor in it may be dissected off under direct vision (Fig. 27) After that portion of the parotid gland superficial to the nerve and its branches has been excised, the remnant of gland behind the nerve plexus can only be removed piecemeal. Extension of the tumor mesial to the nerve plexus often occurs. It is advisable to dissect out and preserve the ramus marginalis mandibulae to avoid permanent facial paresis. Except in widely infiltrating tumors it is not necessary to remove every vestige of the parotid gland but rather to remove that portion within which the tumor is embedded

The wound is drained routinely because dissection is extensive and the operative defect large Skin flaps are approximated to the underlying tissues snugly by use of bulky pressure dressings. The drain is removed on the first postoperative day, and pressure dressings are replaced for an additional 24 hours.

Anomalies of First Branchial Cleft. Louis T Byars and Robin Anderson[7] (Washington Univ) state that during the fourth embryonic week, five branchial arches separated by branchial clefts, appear on the ventrolateral surfaces of the head of the human embryo (Fig 28) Comparable entodermal pouches develop from the rudimentary pharynx bulging laterally to meet the ectodermal grooves between the arches Thin plates consisting of a layer of mesoderm between the ectoderm of the groove and pharyngeal entoderm, are thus formed. Each branchial arch develops a cartilaginous core a blood vessel, and various muscles and nerves The first branchial arch bifurcates into maxillary and mandibular processes From the maxillary process ultimately develop the lateral portion of the upper lip cheek, maxilla part of the palate parotid gland and ventral or anterior half of the auricle The mandibular portion gives rise to the lower lip soft tissue of the lower jaw mandible submaxillary and sublingual glands, portions of the tongue and palate, and malleus and incus. The second arch provides the dorsal half of the auricle soft tissue of the upper neck, stapes and styloid process and lesser horn of the hyoid (Fig 29) During the sixth embryonic week, the second arch grows, overlapping the more caudal arches and grooves. The ectodermal cavity or cervical sinus, thus produced normally disappears The usual branchial cyst or fistula is a persistence of this cavity with an opening into the pharynx

(7) Surg., Gynec. & Obst 93 53 758 December 1951

via the remnants of the second cleft From the first branchial pouch develop the lining of the middle ear mastoid cells and eustachian tube Its corresponding ectodermal groove produces the external auditory canal and outer surface of the tympanic membrane An anomaly of the first cleft thus should be found high in the neck, above the level of the hyoid, below the lower border of the mandible, and probably opening into or in close proximity to the external auditory canal.

Three cases of anomalies of the first branchial cleft were seen. One was in a girl, 16 with a history of having had a

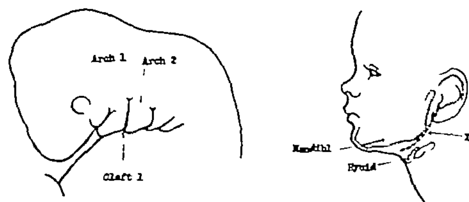


Fig 28 (left) —Five week human embryo. Initial development of branchial arches and clefts

Fig. 29 (right) —Structures derived from first and second branchial arches. Approximate sit of embryonic first cleft is shown as heavy broken line (x) and marks expected position of anomaly deri ed from this cleft

(Courtesy of Byars, L. T., and Anderson, R. Surg., Gynec. & Obst. 93 53-758 December 1951; after Arey L. B. Developmental Anatomy [Philadelphia W B. Saunders Co. 1946])

cyst below the angle of the jaw opened at 6 months. It had continued to drain, together with a persistent ear discharge One was in an infant, 1, who had undergone unsatisfactory incision and drainage of what had been considered an abscess of the jaw The third was in an infant, 19 months, who had persistent discharge from a small opening below the middle third of the left mandible and an ear discharge Surgical excision is the preferred treatment.

Technic —Injection of methylene blue into the external orifice with mild pressure may be useful in outlining the course of the tract. An elliptic incision is made around the external opening, in the place of the skin crease and the tract is gradually dissected free It is followed posteriorly beyond the angle of the mandible and then upward through the parotid gland When further dissec

tion through the anterior incision becomes difficult, a second incision is made along the anterior border of the ear, extending slightly onto the neck. The anterior surface of the tragal cartilage is followed upward. The facial nerve must not be injured. When the termination of the tract in the ear canal is encountered, dissection is continued anteriorly and downward through the substance of the parotid until the previous plane of dissection is reached and the tract is free except for its attachment to the ear canal. The cuff of cartilage extending from the ear canal onto the sinus tract is excised with the specimen. No attempt is made to close the cartilaginous defect in the ear canal.

Microscopic examination of the three surgical specimens showed stratified squamous epithelium, with hair follicles, sebaceous and sweat glands lining the tract. The foremost factor in making the diagnosis of a first cleft anomaly is keeping in the mind the possibility of such a lesion in the patient with cystic swelling or draining fistula high in the neck. Accompanying ear discharge without middle ear infection and ruptured tympanic membrane are confirmatory.

Radical Operation for Carcinoma of External Auditory Canal and Middle Ear Grant E Ward, Walter E Loch and Walter Lawrence, Jr [8] (Johns Hopkins Univ) state that treatment results in such carcinoma have been most disappointing because of delay in diagnosis, limited therapeutic procedures and difficulty in access to this region Major symptoms are pain, bloody otorrhea, hearing loss, vertigo and ipsilateral facial paralysis. X ray study of the mastoids is useless in diagnosis because of radiologic changes due to long standing pre-existing inflammation. Diagnosis is based on direct biopsy and exploratory surgery to visualize the middle ear cavity or mastoid. Squamous cell carcinoma is the most common type of malignant tumor Routine radical mastoidectomy with postoperative irradiation does not adequately attack the cervical metastases, the primary site or local extension into the soft tissues.

Radical neck dissection in continuity with wide removal of the primary disease is essential treatment for all cancer of the middle ear or external auditory canal The operation was performed on five patients, three of whom had primary carcinoma of the auditory canal involving the middle ear One had recurrent carcinoma originally arising in preauricular skin and later invading the face and middle ear In

(8) Am J Surg 82:169 172 July 1951

another patient, the primary site of the tumor was never determined but secondarily it involved the external auditory canal and middle ear after previous resection of the cervical mass

Pain was the predominant symptom in each patient four of whom were completely relieved, while one continued to have some pain. The lymph nodes were involved in all in three the nodes were palpable preoperatively and in two microscopy revealed metastases. One patient was free from pain and demonstrable disease 17 months after operation

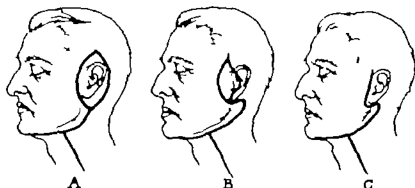


Fig 30.—Kocher Y incision for radical dissection of lymph-bearing neck fascia. *A* posterior end of horizontal limb extended elliptically to include entire pinna which is removed with specimen *B* extended ellipse includes tragus and involved preauricular skin; *C* incision extended in preauricular region for reflection of pinna posteriorly to reach external auditory canal. This permits resuture of the pinna. (Courtesy of Ward G E *et al* Am. J Surg 82 169 178 July 1951)

when she was accidentally killed. Another died nine months after surgery following a two day illness without external evidence of cancer A third died of cancer two months after operation. A fourth had a small recurrence in the neck out side the field of postoperative x ray therapy seven months after surgery This recurrence was given intense irradiation, but the patient died nine months after surgery The fifth patient was comfortable but had metastases on the opposite side of the neck and a small ipsilateral recurrence

Technic.—A Kocher Y incision permitting dissection of anterior, posterior and superior skin flaps to expose the field (Fig 30), is used. The usual classic neck dissection is adhered to in the cervical portion of the operation The sternocleidomastoid muscle is tran sected to expose the jugular vein which is ligated above the clavicle with four silk ligatures and divided between the middle two The sternocleidomastoid muscle jugular vein, carotid sheath and lymph

bearing fascia are dissected superiorly. The edge of the trapezius muscle is the posterior limit of the dissection. The submental and submaxillary triangles and remainder of neck fascia are dissected. Dissection of the posterosuperior limits of the wound is most

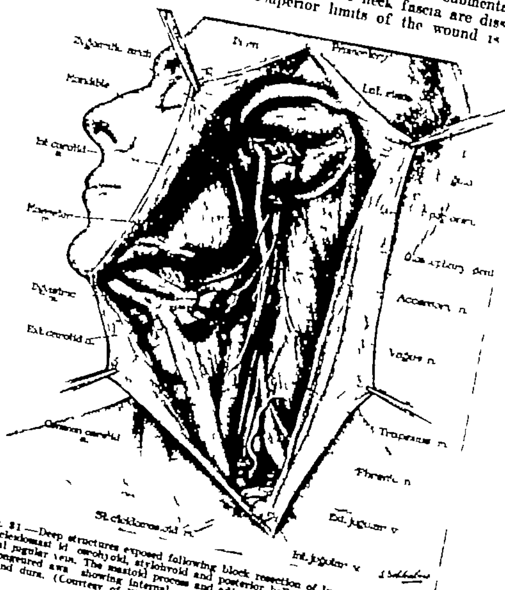


Fig. 31.—Deep structures exposed following block resection of lymph-bearing fascia, sternocleidomastoid, omohyoid, stylohyoid and posterior belly of digastric muscles and internal jugular vein. The mastoid process and adjacent portion of temporal bone have been rongeured away showing internal carotid artery and its bony canal, the lateral sinus and dura. (Courtesy of Ward, G. E., et al: Am. J. Surg. 82:169-178, July 1951.)

difficult and depends on the extent of the tumor. In three patients the parotid gland, facial nerve and varying amounts of preauricular skin were excised en bloc with the cervical specimen. The lymph node metastases in the region of the mastoid necessitate resection of generous portions of the splenius capitus muscle. The jugular vein is ligated and divided as high as possible (Fig. 31). In several

patients, dissection near the jugular foramen was tedious and difficult. In three patients the condyloid process of the mandible was excised with the block and in two the zygomatic arch was removed.

The mastoid process is extensively resected, always uncovering the lateral sinus, jugular bulb and dura mater and frequently unroofing the carotid artery. Involved parts of the dura may be resected and replaced with fascia. The bony structure of the external canal is always removed since tumor is often found in adjacent soft tissue. The capsule of the temporomandibular joint is exposed and resected when necessary. The labyrinth should be removed if necessary. The facial nerve is frequently embedded in tumor and must always be sacrificed.

The piecemeal excision of tumor from the bone and the danger of leaving carcinoma cells behind make postoperative irradiation imperative. In all but one patient the portion of the wound overlying the region of the bone excavation was packed open. In three of these, a split thickness graft was used to cover the bone defect after irradiation.

Carotid Body Tumors are not common, but importance of adequate treatment of these neoplasms prompted a report on eight cases by James W. Hendrick[9] (San Antonio, Tex.). Carotid bodies are bilaterally situated in or near the crotch of the common carotid artery, where a neoplasm may involve the jugular vein, the vagus, hypoglossal and glossopharyngeal nerves, sympathetic chain, the pharynx and arteries. Carotid bodies and the carotid sinus are not physiologically or anatomically related. The only pathologic lesion of the carotid body yet observed is tumor formation. Growth of such tumors is slow; they remain generally ovoid or spherical, lobulated and encapsulated unless malignant transformation takes place. Although malignant change is found, frequency is disputed. In two of the eight cases, there was microscopic evidence of malignant change; in both, surrounding tissues were infiltrated. The tumors are essentially asymptomatic. Physical findings, other than a mass, are variable, depending on size and attachments of the tumor. Such tumors may be difficult to differentiate from branchiogenic cyst and carcinoma, neurofibroma, metastatic carcinoma, primary lymphoma and tuberculous lymphadenitis. Laboratory procedures and roentgen examinations rarely help.

Treatment is primarily surgical. If malignancy is suspected and the carotid vessel has to be sacrificed for ade-

(9) Surgery 31:395-402, March, 1952

quate resection, systematic, periodic pressure applied to the common carotid artery preoperatively will improve collateral circulation. Even adequate preoperative compression does not always insure against cerebrovascular accident when the common or internal carotid vessel must be ligated

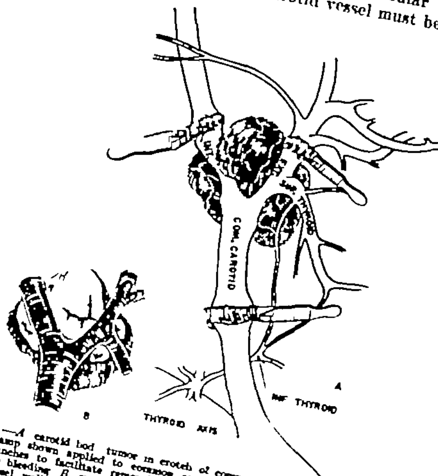


Fig. 32.—A, carotid body tumor in crotch of common carotid artery. Rubber-shod bulldog clamp shown applied to common carotid artery and internal and external carotid branches to facilitate removal of tumor without injury to vessel walls or troublesome bleeding. B, cross section of carotid vessels showing that tumor had not invaded vessel walls. (Courtesy of Hendrick, J. W.: Surgery 31: 385-402, March, 1952; from Ward, O. E., and Hendrick, J. W.: Tumors of the Head and Neck, [Baltimore: Williams & Wilkins Company, 1950].)

(Fig 32) Since secondary thrombosis may contribute to delayed cerebral complications, anticoagulant therapy and regional sympathetic procaine block should be considered. Technically important in tumor removal are adequate exposure, control of large blood vessels and saving as many vitally important structures as possible. Malignant tumors require radical neck dissection. Although results have not

been impressive deep x ray therapy was used postoperatively for two invasive malignancies

Treatment of Cervicofacial Actinomycosis with Special Regard to Penicillin Therapy Mogens Glahn[1] (Copenhagen) reports results in 90 cases of actinomycosis of the face and neck, which were divided into typical and nontypical, according to bacteriologic findings. Penicillin therapy was given in 54, with complete recovery in 52 The antibiotic had an immediate effect in two but failed to produce complete recovery

A comparison of results with penicillin treatment and with roentgen therapy, both combined with adequate surgery showed that penicillin is capable of producing complete healing in 25-50% of the time taken by previous methods. It is unnecessary to combine penicillin therapy with irradiation, though a single series of roentgen treatments is justifiable if acceleration of abscess formation is desired for diagnostic reasons. Adequate penicillin dosage in typical cases is 600 000-1,000 000 units daily for 10-20 days or more and in nontypical cases 300 000 units daily for 8-14 days A sensitivity test is recommended if there is no improvement within one week after treatment is begun.

Diagnosis in these cases is made as soon as possible preferably by bacteriologic examination. All abscesses in soft tissue related to jaws and teeth are suspected of being actinomycotic until proved otherwise Roentgen examination is made to detect any source of infection in the jaws Penicillin is given systemically locally or both in adequate doses, and surgical removal of the focus, if any is done Penicillin therapy is continued until the swelling has disappeared, and a weekly follow up examination is made for one to two months

[These are the most striking results with penicillin that I know of.—Ed.]



(1) Acta chir scandinav 102 433 446 1952.

Surgical Aspects of Thyroid Disease Edward S Judd, Jr[2] (Mayo Clinic) believes the antithyroid drugs bid fair to reduce the need for surgery in toxic goiter Subtotal thyroidectomy is the preferred treatment for uncomplicated exophthalmic goiter For hyperthyroidism with exophthalmic goiter, radioiodine is often effective and may become the treatment of choice in view of the 1% incidence of unilateral cord paralysis and the 5% incidence of recurrence after surgery Radioiodine is indicated in (1) persons aged 60 or over (2) younger persons who are poor operative risks and (3) patients with recurrent goiter One stage subtotal thyroidectomy is still used in most other cases

Adenomatous goiter with hyperthyroidism occurs in older patients, usually with cardiac complications (e g., fibrillation), but as a rule subtotal thyroidectomy controls the hyperthyroidism and recurrence is unusual. Thyroidectomy is also indicated for the adenomatous goiter without hyperthyroidism because of the 8% threat of cancer and 50% threat of hyperthyroidism in long standing adenoma Large substernal or intrathoracic goiters require surgery lest respiratory obstruction develop adding to surgical risk.

Thyroiditis includes (1) struma lymphomatosa (Hashimoto's thyroiditis) in which hypothyroidism is found surgery is to be avoided unless subtotal thyroidectomy is indicated for relief of tracheal compression and (2) Riedel's struma in which removal of the isthmus and enough of the lateral lobes to diagnose the presence or absence of cancer is indicated though fraught with danger because of fixation and friability

Thyroid adenocarcinoma grows rapidly Surgery is needed to relieve respiratory obstruction and for biopsy As much cancer tissue is removed as is feasible with tracheotomy if necessary followed by postoperative irradiation. Malignant adenoma of the thyroid may be successfully treated by removal of the entire affected lobe if diagnosed early Papillary carcinoma, the first sign of which may be involvement

( ) J Maine M A. 43 1 7 January 1952

of cervical lymph nodes, responds well to surgery, even when the sternocleidomastoid muscle and internal jugular vein are spared, the five year survival rate being higher than 90%

Treatment of Hyperthyroidism Evaluation of Thyroidectomy, of Prolonged Adminstration of Propyl Thiouracil and of Radioactive Iodine George Crile, Jr and E Perry Mc Cullagh[3] (Cleveland Clinic) prefer thyroidectomy after preparation with propyl or methyl thiouracil for patients with nodular goiter with hyperthyroidism Mortality is less than 1% and morbidity has been lowered by adoption of an anatomic technic in which the superior pole is isolated and divided, the lobe rotated from its bed, the inferior thyroid artery ligated well away from the gland, the recurrent nerves and parathyroid bodies identified and preserved and all of the thyroid except a thin shell of the posterior capsule is removed. Thyroidectomy is more effective for nodular goiter with hyperthyroidism than it is for Graves' disease and removal of almost all thyroid tissue is more satisfactory than incomplete operations Recurrent hyperthyroidism is five times as common after operations for Graves' disease as after those for nodular goiter with hyperthyroidism (1%) Hypothyroidism is rarely seen after operations for nodular goiter with hyperthyroidism but was seen in 21% of patients operated on for Graves' disease Injury to the recurrent laryngeal nerve occurred in 15% before it was identified as routine Two patients died after surgery due to injury to the recurrent laryngeal nerve

Prolonged treatment with propyl or methyl thiouracil in an attempt to induce permanent remission is acceptable for young patients with small diffuse goiters and can also be used as an alternative to I^{131} in aged or debilitated patients regardless of the type of goiter A dose of 300-400 mg /day in four doses every six hours is eventually effective in nearly all patients. If hypothyroidism develops it is controlled more easily by giving small doses of thyroid than by re adjusting the dose of propyl thiouracil. Toxic effects such as fever rash, urticaria, numbness, arthralgia and leukopenia occurred in 2.5% and the drug had to be discontinued in only 3 of 218 patients. Development of carcinoma in

(3) Ann. Surg 134 18-28 July 1951

a gland treated with a thiouracil derivative is unlikely

Propyl thiouracil is indicated in patients with Graves' disease associated with small or medium sized diffuse goiters and in all poor surgical risks with hyperthyroidism Patients with nodular goiters with hyperthyroidism should have thyroidectomy because of cosmetic considerations and possibility of developing carcinoma. Seventy of 141 patients given propyl thiouracil had long standing remissions after withdrawal of therapy If hyperthyroidism does not recur in four months the remission will be prolonged. Incidence of remissions was 62 per cent in Graves' disease and only 34 per cent in nodular goiter Height of the basal metabolic rate before treatment has little relation to final results In a selected group of patients, incidence of remission should be as high as 75 per cent

Physical and physiologic characteristics of I131 make it well adapted for treatment of hyperthyroidism It is the preferred measure for older patients with Graves' disease for patients with recurrent hyperthyroidism for elderly patients with nodular goiter with hyperthyroidism and for a selected group of younger patients with Graves' disease Advantages are that it is a simple medication to take little professional supervision is needed there is no mortality or morbidity and no discomfort. Incidence of recurrent hyperthyroidism is low and, when it does occur it can be controlled by another treatment.

Slow Response to Preoperative Antithyroid Therapy in Severe Hyperthyroidism. Donald C MacKinnon[4] (Minneapolis) reports two cases one of delayed response to propylthiouracil and one of stubborn resistance to the drug

CASE 1.—Woman, 64 had been advised to have thyroidectomy 20 years previously but had refused because symptoms were minimal. About 14 years later the thyroid began to enlarge and she complained of nervousness. During the six years before admission symptoms progressed. On admission BMR s ranged from +32 to +41% Diagnosis was toxic nodular goiter Thiouracil 0 6 Gm. daily was given for one week but was discontinued because of a skin rash. Lugol s solution 30 drops daily, produced no change in six weeks. In addition, propylthiouracil, 150 mg daily was then given and was increased in about six weeks to 200 mg daily About three months later BMR s ranged from +10 to +15% Propyl thiouracil was given for over 10 months, at times with Lugol s solu

(4) Minnesota Med. 34 584 590 June, 1951

tion, after which BMR's were +10 and +3% Subtotal thyroidectomy was then done but the patient died eight hours after operation, apparently in thyroid crisis

CASE 2.—Man, 38 with a history of nervousness and tremor of the hands for eight months, had a BMR of +67% Diagnosis was diffuse hyperplastic goiter with thyroid toxicosis. Propylthiouracil, 200 mg and later 400 mg daily, was given for over six months, part of the time with 30 drops of Lugol's solution daily, but the BMR remained between +50 and +60% At the end of this period radioactive iodine (I^{131}) was given Propylthiouracil, 400 mg daily, was again administered, and five months later BMR's ranged between 0 and +15% There was marked symptomatic improvement Subtotal thyroidectomy was done without incident. Two weeks later the BMR was 0%

Ordinarily both of these patients would have responded satisfactorily to propylthiouracil in three months. The favorable effect of therapy in Case 2 was probably wholly due to the radioactive iodine. This radioactive isotope is to be regarded as a valuable adjunct when used in preoperative preparation of patients resisting propylthiouracil therapy

Relapsing Goiter and Iodine Prophylaxis is discussed by M. Richard[5] (Rorschach, Switzerland) Frequency of relapsing goiter is determined by intensity of goiter endemia prophylaxis and technic used at initial goiter operation. *Relapsing goiter is clinically and histologically the same* as the original goiter and geographic distribution is the same Prophylactic measures against goiter must accordingly also influence relapsing goiter Such measures are directed against lack of iodine lack of vitamin, especially vitamin A, and poor hygienic conditions.

Reliable data are available only about prophylactic measures against lack of iodine chief of which is addition of 5 mg potassium iodide to every kilogram of table salt With *average intake at 10-15 Gm. a day this provides 88-107/μg* of the necessary 200 μg iodide Results of iodine prophylaxis have been most striking in younger age groups In 1921 22, 100% of babies born in northeast Switzerland had goiter in 1950-51 none had it. Goiter was found in 60-*80% of schoolchildren before and in 8-10% after iodine* prophylaxis was instituted. Goiter occurred in children from the countryside five to six times as often as in urban children This is believed due to less hygienic conditions and

(5) Helvet chir acta 18 505-516, December 1951

lack of vitamin A in rural areas. The same factors seem important among older groups where goiter rate has decreased from 66.5% only to 46.3% despite iodine prophylaxis.

Relapses after thyroidectomy are most frequent among patients operated on before age 30 and generally occur 15-20 years after initial surgery. Rates cited by various authors range from 7 to 10.5%. In northeast Switzerland records show reoperation in 0.26% of thyroidectomized patients as against a calculated 2.9% frequency of relapses. Surgery consisted of bilateral resection with main arteries ligated, complete removal of the pyramidal lobe and careful excision of adenomas and retromediastinal and intrathoracic parts of the goiter. All patients with euthyroid goiter were given 3 drops of 1:1,000 potassium iodide solution, which corresponds to 114 μg./day. A daily intake of 200-280 μg is believed beneficial after surgery; this amount can be given safely without risk of causing toxic goiter or Graves' disease.

Patients operated on for hyperthyroid goiters should be treated postoperatively with organic iodine compounds in individually calculated doses.

Radioactive Iodine as Adjunct to Surgical Management of Diseases of Thyroid. Brown M. Dobyns[6] (Harvard Univ.) reviews the practical applications of I131 in diagnosis and treatment of thyroid disease. Measurement of radioactivity in the thyroid area or measurement of I131 in the blood or urine after a test dose aids diagnosis of Graves' disease. In this disease the thyroid collects a larger percentage of iodine than does a normal gland, and less is excreted in urine. Normal subjects retain an average of 34.1 per cent of a test dose in 48 hours, whereas patients with thyrotoxicosis have much higher retention. Sources of error in these studies are ingestion of iodine, thyroid extract, thiouracil or thiocyanate by the patient and presence of kidney disease or congestive heart failure. Thyrotoxicosis factitia can be detected since ingestion of desiccated thyroid extract suppresses thyroid function; thus, uptake of I131 is almost zero. Localization of I131 near the ovary may lead to a presumptive diagnosis of struma ovarii.

Radioautographs, images produced on photographic film

(6) Surg. Gynec. & Obst. 93:415-4[illegible]7, October 1951.

by exposure to microscopic preparations of thyroid tissue which contain I^{131}, allow correlations of hyperactivity with histologic appearance. By this method, some histologically hyperplastic nodules are found to have excessive function whereas others have almost none In general, degree of function (uptake of I^{131}) parallels degree of differentiation. Colloid nodules consisting of low epithelium, though appearing well differentiated, are an exception Information on the function of nodules preoperatively may be gained by counts of radioactivity in standard cross-section areas over lying the thyroid. This is particularly applicable to those patients with a single discrete nodule, for good comparisons can be made from counts from the area of the nodule and from an uninvolved portion of the same gland. Graves' disease with an incidental nodule or nodules and a hyperfunctioning nodule or several nodules with thyrotoxicosis can also be distinguished by means of radioautographs or the directional counter With this information at hand before operation, a procedure which fits the need may be planned

In the occasional patient in whom subtotal thyroidectomy for thyrotoxicosis may impose considerable risk, appropriate doses of I^{131} may be given under careful control to cause inactivity of the gland. Use of I^{131} in carcinoma of the thy roid is limited most successes occurring in patients with the follicular type of adenocarcinoma. Complete removal of all normal thyroid tissue and administration of thiouracil may augment the I^{131} uptake in some metastases from car cinoma of the thyroid. Little or no success has been achieved in solid cellular carcinomas or papillary adenocarcinomas. Radical surgical excision remains the first and most impor tant method of attacking the primary disease

Radioiodine (I^{131}) Tracer Studies after Total Thyroidectomy D Emerick Szilagyi, Roy D McClure Thomas H. Connell Jr., John H. L Watson and Luther E Preuss[7] (Henry Ford Hosp., Detroit) followed the clinical course of 52 patients after removal of all grossly recognizable portions of the thyroid gland and noted that depression of thyroid function was much less pronounced than in pri mary myxedema To learn the cause of this seeming para dox, 22 patients were studied with radioiodine tracers for

(7) Ann. Surg. 134:646-665 October 1951

1-60 months postoperatively, for traces of thyroid tissue in the neck or elsewhere A tracer dose of 50 μc of eight-day half life iodine isotope (I^{131}) was given orally and uptake was determined by scanning the thyroid area and other regions that might harbor thyroid tissue The cumulative urinary excretion of the tracer in 96 hours was also determined

In 54 5% of patients, active thyroid tissue was found in the thyroid regions In 4.4% thyroid remnants had sufficient function to maintain the patients in approximately euthyroid state As a group, they showed a rough parallel between excretion curves and iodine uptake, but with one exception all excretion curves were definitely in the hypothyroid range. This suggests that iodine utilization by small parenchymatous remnants had characteristics different from those observed in the intact gland.

There is evidence that when the original lesion was hyperactive there was more likelihood of active thyroid remnants There was a parallel between clinical state of thyroid function and BMR, blood protein bound iodine and cholesterol. The glucose tolerance was normal and renal function was not impaired. Exact sites of thyroid tissue remnants were not localized because scanning technic is not yet precise enough. Most likely sites are regions of parathyroid bodies and points of entrance of the recurrent laryngeal nerves at the cricothyroid angle

It is impossible to predict the degree of radicality of total thyroidectomy, the differences between the hypo- and athyreosis of the totally thyroidectomized patient and the patient with primary myxedema are quantitative rather than qualitative Euthyreosis in a patient after total thyroidectomy is due to active thyroid remnants. Although the amounts of thyroid extract needed to maintain a fairly normal state showed wide individual variations unrelated to the uptake counts, there was a rough parallel between the BMR, uptake count and cumulative excretion.

[Very interesting use of a new method to demonstrate the difficulty of achieving a complete thyroidectomy.—Ed.]

Superior Laryngeal Nerve in Thyroid Surgery After thyroidectomy there may be voice changes without obvious paralysis of the vocal cord on laryngeal examination. These

are usually considered due to laryngeal edema or postoperative tracheitis R E Moran and A. F Castro[8] (Washington, D C) state that the external branch of the superior laryngeal nerve, which supplies the cricothyroid muscle with motor fibers, lies in close relation to the superior thyroid artery at the upper pole of the thyroid (Fig 33) and therefore is easily included in a ligature of this artery This may cause paralysis of the cricothyroid muscle on the

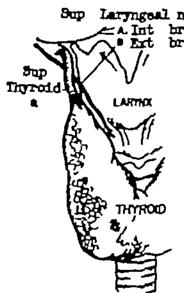


Fig 33 —Superior pole of thyroid. (Courtesy of Moran, R. E. and Castro, A. F: Ann. Surg 134 1018-1021 December 1951)

affected side which results in a monotonous hoarse toneless and feeble voice Normally the muscles depress the anterior portion of the thyroid cartilage thereby stretching and adducting the vocal cords When they are paralyzed, laryngoscopy shows some atrophy of the affected cord and wavy irregularity of its free border Complete adduction of the affected cord is impossible

To test this theory the external branch of the superior laryngeal nerve was purposefully traumatized with a small hemostat in eight consecutive patients with adenomatous goiter In four, trauma was produced unilaterally, in four bilaterally The four patients with unilateral trauma had a hoarse, monotonous voice for five to seven days postopera

(8) Ann. Surg 134 1018-1021 December 1951

tively The four with bilateral trauma had the same changes in the voice plus easy fatigability Two to six months post operatively, they showed definite improvement in quality of the voice, there were no detectable residual changes in the one followed six months

Injury to the external branch of the superior laryngeal nerve can best be avoided by dissecting the superior pole of the thyroid from below upward (and not from above downward), since separation of the nerve from the artery is thus facilitated. Although such injury does not have the grave consequences of injury to the recurrent laryngeal nerves, it is annoying to the patient and often a source of worry to the surgeon. If it occurs together with recurrent nerve paralysis, it may produce complete abduction of the vocal cord.

Vocal Cord Paralysis Following Thyroid Surgery Study of 104 Cases Otto H. Meurman[9] (Univ of Helsinki) found unilateral paralysis in 52 patients and bilateral paralysis in the other 52 Of the latter group 38 had had a single operation, an indication that injury to both recurrent nerves during the same operation is not uncommon In 97 patients paralysis had developed during and in 7 after surgery In 42 patients with unilateral palsy the recurrent nerve was totally paralyzed and the paralyzed cord was fixed in the median paramedian position (Figs 34 and 35) In nine both motor nerves were injured on the same side and the vocal cord was immobile in the intermediate position. Partial paralysis of the recurrent nerve (abductor or posticus paralysis) was noted in only one patient In patients with bilateral paralysis, 33 had totally paralyzed recurrent nerves (Fig 36) 18 had partial paralysis of the recurrent nerve on one or both sides and one had paralysis of both motor nerves

With unilateral recurrent nerve palsy the voice was initially hoarse the degree of hoarseness varied because the paralyzed cords in paramediate position were not always equally close to the midline A contributing factor may be that it takes time for voice production to succeed with only the cricothyroid muscle acting A gradually paralyzed cord influenced by this muscle, nears the midline and, in phona

(9) Acta chir scandinav 101 360 378 1951

tion, the healthy cord in turn gradually moves beyond the midline to the paralyzed side, consequently the voice clears, often becoming quite normal With both laryngeal motor nerves paralyzed, the voice became permanently hoarse or aphonic In bilateral paralysis of the recurrent nerve the initially hoarse voice gradually improved, but was not com pletely restored The cricothyroid muscles also cause approximation of the cords in bilateral paralysis In partial bilateral paralysis of the recurrent nerve the glottis closed completely during phonation and the voice was therefore almost normal.

Dyspnea was the most striking symptom of bilateral paralysis In 37 patients it started suddenly during surgery and either remained unchanged or increased. In 14 patients

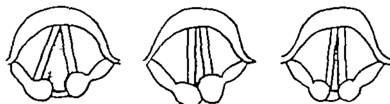


Fig. 34 (left) —Position of vocal cords on respiration with paralysis of left recurrent nerve.
Fig. 35 (center) —Position on phonation with paralysis of left recurrent nerve.
Fig. 36 (right) —Bilateral recurrent nerve paralysis. Vocal cords in same position during respiration and phonation. The posterior part of glottic space is 1-3 mm. wide.
(Courtesy of Meurman, O. H.: Acta chir. scandinav 101:360-370 1951)

it was initially mild and gradually increased Increase in dyspnea was caused by moving of the vocal cords nearer each other Sudden aggravation was usually the result of upper respiratory tract infection. In unilateral recurrent nerve paralysis dyspnea did not ordinarily appear In two patients the arytenoid cartilage had tilted so far forward that free passage of air through the larynx was hindered, causing severe dyspnea. Of 78 patients, 61 had deglutition difficulties for the first few postoperative days or weeks.

Laryngoscopic examination is the only means of determin ing recovery from paralysis swallowing difficulties and hoarseness tend to disappear with time—the former com pletely at times. The vocal cord was laterally fixed by the methods of Y Meurman and De Graaf Woodman in 38 pa tients with bilateral recurrent paralysis In one of two pa tients whose arytenoid cartilage had tilted forward, the

method of retrofixation was used In three patients with the paralyzed cord in intermediate position, the method of medial fixation was used to improve the voice Results were extremely good in most instances and indicate that laryngeal surgery may relieve discomfort in such patients.

[Practically always the voice returns to a nearly normal condition when only one vocal cord is paralyzed. In those cases in which a return of function seems slow some speech training will often prove helpful.—Ed.]

Postoperative Tetany Study Based on 40 Treated Cases following thyroidectomy is presented by H. Wijnbladh[1] (Stockholm) Most important sequelae are cataracts, mental disturbances and various ectodermal symptoms Cataracts developed in five patients. Cataract necessitating surgery may develop soon (under seven months) it may follow tetany so mild that it cannot be diagnosed or even suspected, whereas it does not necessarily follow prolonged illness and repeated attacks of manifest tetany Mental symptoms resemble those in inadequately treated diabetics Patients are sluggish and inaccessible frequently refusing to co-operate they are difficult to treat

Diagnosis may be difficult Most important, in absence of spasms, is subjective discomfort such as numbness and tingling sometimes so slight as to escape observation or developing so late that tetany is undiagnosed unless it is kept in mind Trousseau's phenomenon may not appear despite low blood calcium level. It was noted with blood calcium at 6-7 8 mg/100 ml. in one 8 5 mg in another and 7 5 mg in a third patient who eventually had manifest tetany Trousseau's phenomenon and spasms are not directly related to blood calcium level Estimate of blood calcium level on the day after operation was useful 10% decrease indicated tetany which eventually became manifest. Even lighter decrease may suggest tetany with long clinical latency and no Trousseau phenomenon. One patient showed tetany 10 years after operation. Manifest tetany may be provoked by menstruation, infections or lactation and such patients may become problems to the gynecologist

Without additional calcium, symptoms subsided and blood calcium rose to normal level with calciferol. Patients previously treated with A.T.10 could take calciferol instead

(1) Acta endocrinol. 10 1 16 1952.

Calcium gluconate was first given intravenously with 37.5 mg calciferol orally to control symptoms, dosage was gradually reduced to 5-25 drops daily of oily solution containing 14.5 mg calciferol/cc for maintenance In five patients dosage was gradually reduced until none was given, subsequent observation was long enough to indicate definite cure Calciferol is far less costly than A.T 10 Untoward effects, indicated by blood calcium level of 14-14.5 mg./ml., were noted in two patients, such patients need careful follow up

Treatment of Nodular Goiter is reported in 200 patients by Louis Hermanson S L Gargill and Mark F Lesses[2] (Harvard Med. School), especially in relation to malignancy Indications for operation were (1) nodule alone, 67 patients (2) nodule with growth or pressure symptoms, 91, (3) nodule with thyrotoxicosis, 33, (4) recurrence of nontoxic nodule, 14, and (5) recurrence of nodule with thyrotoxicosis, 5 Types of operation done included (1) excision of nodules, 72 (2) unilateral subtotal thyroidectomy 48, (3) unilateral subtotal thyroidectomy and excision of isthmus or of nodule in opposite lobe, 7 (4) bilateral subtotal thyroidectomy, 51 (5) unilateral total hemithyroidectomy 28 (6) bilateral total thyroidectomy 2, (7) biopsy, 1 and (8) excision of glands, 1—or a total of 210 operations.

Of 190 patients, 137 had solitary nodules on clinical examination but histologic study revealed multiple nodules in 43 of these Histologic study revealed multiple nodules in 91 as against 34 diagnosed clinically Both single and multiple nodules were found in 18 clinically non nodular thyroids Thus, clinical attempts to distinguish between uni and multinodular goiter are of doubtful value

There were 183 thyroids with nonmalignant nodules, and 27 with malignant nodules 2 of them recurrent—an incidence of malignancy of 12 5% (14 4% uni and 10 4% multinodular cases) Papillary carcinoma, 15 cases, and angioinvasive (embryonal and fetal) adenoma, 6 cases were the most common Invasion beyond the thyroid capsule was found in 24% of the 25 patients with thyroid cancer Only one patient showed unequivocal clinical signs of thyroid cancer Thyroid cancer was an unexpected finding in asymptomatic nodular goiter

(2) J Clin. Endocrinol 12 112 129 January 1952.

High incidence of malignancy in thyroid nodules indicates that nontoxic nodular goiters should be surgically explored even when there are no symptoms, because incidence of malignancy seems constant despite a reduced prevalence of endemic goiter and nodular thyroid enlargements Total thyroidectomy is the choice whenever cancer is evident at operation, if future treatment with radioactive iodine is contemplated Postoperative external radiation is of doubtful use

Radical neck dissection is reserved for transcapsular spread and does not appear justified routinely in thyroid cancer Adequate surgery should consist of unilateral total lobectomy or bilateral thyroidectomy, depending on the nature and extent of the lesion Follow up of 25 patients with thyroid malignancy ranged from 1 to 17 years, only 2 died during an average follow up of 7 years

Complications of operation included (1) unilateral recurrent nerve paralysis in 8.1% (permanent in 7.15%), (2) bilateral recurrent nerve paralysis in 1.9% (all transitory) (3) tetany in 1.9% (permanent in 0.5%), (4) myxedema in 6.2%, and (5) hemorrhage pulmonary atelectasis, wound sepsis or hematoma in 4.7% Recurrent laryngeal nerve injury was commonest when a large nodule involved a single lobe and required only unilateral thyroidectomy Mortality was 0.5%

Intrathoracic Goiter lies entirely or in major portion, within the thorax. F Henry Ellis, Jr., C Allen Good and William D Seybold[5] (Mayo Clinic) encountered 24 cases of intrathoracic goiter removed by routes other than through cervical incision. Only 12 patients gave histories of previous thyroidectomy Only 12 had complained of symptoms referable to intrathoracic tumor and mediastinal pressure symptoms predominated. Irritative, nonproductive cough dyspnea and thoracic pain were the commonest symptoms Mild dysphagia and wheeze were also encountered. No thyroid gland was palpable in 14 patients 6 of whom had not had thyroidectomy Though laryngoscopic or bronchoscopic examinations were not routine, fixed vocal cord was noted preoperatively in four patients and, on bronchoscopy narrowing of the trachea and/or bronchus in five A tracer

(5) Ann. Surg 135: 9-90 January 1952.

dose of I^{131} was used for preoperative diagnosis in two patients Basal metabolic rates of three patients with clinical evidence of thyrotoxicosis were elevated but dropped after goiter removal. Visible pulsation of tumors in two patients serves to warn that this phenomenon does not necessarily establish a diagnosis of aneurysm

X ray evidence of nonpulsating tumor in the upper part of the mediastinum, displacing the trachea and showing upward motion on swallowing, was considered significant. Of 24 intrathoracic goiters, 18 were on the right side, 14 were in the posterior mediastinum or the posterior part of the superior mediastinum. Of the latter, 11 were in a triangle bounded anteriorly by the superior vena cava, inferiorly by the azygos vein and posteriorly by the posterior wall of the thorax. Two tumors in the posterior mediastinum proved to be metastatic lesions from primary thyroid neoplasms X ray study showed calcium deposits in nine goiters. The trachea and/or esophagus was deviated in some patients. Intra thoracic goiter was diagnosed preoperatively by x rays in 7 cases combined clinical and x ray data indicated intra thoracic goiter in only 14 X ray examination should include stereoscopic posteroanterior single lateral views and fluoroscopic observation.

Operative removal is always indicated because of threat of hyperthyroidism, malignant change and/or mechanical interference with the airway Three groups of intrathoracic goiters are to be considered in selecting operative approach (1) masses in the anterior mediastinum and anterior part of the superior mediastinum with nodular goiters in the neck (2) masses in the posterior part of the superior mediastinum with or without palpable cervical goiter and (3) masses in the anterior or posterior mediastinum un associated with nodular cervical goiter For group 1, a cervical approach is usually satisfactory with evacuation of the tumor contents by breaking through its capsule when the thoracic component cannot be delivered readily or with enlargement of the thoracic inlet by splitting the sternum, if necessary Cervical origin of blood supply and complete encapsulation of these tumors make these procedures feasible Many group 2 tumors can be similarly handled, but if the thyroid is not palpable the tumor ordinarily lies posterior

to the superior vena cava and azygos veins and should be approached by a posterolateral incision despite threat to the recurrent nerve Group 3 tumors should be approached by splitting the sternum or by posterolateral transpleural route, according to site In these, source of blood supply is often intrathoracic In some cases, previous thyroidectomy may have severed continuity between thoracic and cervical thyroid tissue with thoracic blood supply subsequently established

Operative mortality rate for all intrathoracic goiters was 4.2% Three patients with tumors in the posterior part of the right superior mediastinum had fixed right vocal cords postoperatively Other causes of postoperative morbidity were thrombophlebitis, atelectasis and empyema.

Malignant Lesions of Thyroid Gland were encountered in 284 patients at Mayo Clinic in 1938-47 Oliver H. Beahrs and Edward S Judd, Jr [4] classified them in two groups. (1) Tumors of low grade malignancy included papillary adenocarcinoma (61.2% of cases) and adenocarcinoma in an adenoma (18 4%) (2) Anaplastic rapidly growing tumors included diffuse adenocarcinomas (17 6%), sarcomas (1.7%) and epitheliomas (1.1%)

Papillary adenocarcinoma is characterized by papilliferous projections of epithelial cells with vascularized connective tissue stalks, the regional nodes showing metastases and not, as was formerly thought, aberrant thyroid tissue Adenocarcinoma in adenoma (malignant adenoma) consists of small undifferentiated cells without definite structure (or in follicular arrangement) usually arising from a single benign or "fetal" adenoma and spreading by the blood stream to distant sites and later to regional lymph nodes once the capsule has been transgressed. Diffuse adenocarcinoma is composed of small, round, spindle-shaped or giant cells, becoming fixed from local spread and metastasizing by blood stream and/or lymph vessels Sarcomas and epitheliomas are usually fatal within a year although in this series one patient with sarcoma was alive five years after thyroidectomy

Recent enlargement of a pre-existing goiter or a rapidly appearing goiter may indicate cancer A single thyroid

(4) S. Clin. North America 31 1169 11 7 August, 1951

nodule is more likely to be malignant than multiple nodules. A fixed vocal cord was noted in 13.4% of the patients. Incidence of malignancy in exophthalmic goiter was 0.5% and in nodular goiter without hypertension 7.07%. About 40% of patients diagnosed as having malignant disease of the thyroid, had had goiter or enlarged cervical nodes five or more years. Of the patients with this diagnosis, 35.4% were considered inoperable. In view of these facts surgical removal of nodular goiter is wise, regardless of whether hypertension is present.

If cancer is suspected, definite surgery is indicated. Total lobectomy should be done for cancer of one lobe. For cancer of both lobes, total lobectomy on one side and subtotal on the other or occasionally total thyroidectomy are the preferred procedures. For carcinomatous extension beyond the thyroid capsule with true fixation of the tumor to adjacent tissue, operation is not indicated except for papillary adenocarcinoma. If the vein is involved but the lesion is otherwise operable removal is indicated but usually distant spread has occurred. For papillary tumors, local excision of metastatic lesions of cervical nodes, together with accompanying nodes and fascia is adequate. Radical dissection of the cervical nodes is not indicated. In 22.2% of the 284 patients, biopsy only was done; in 4.9% partial lobectomy, in 48.6% total lobectomy; in 23.6% subtotal thyroidectomy; and in 0.7% total thyroidectomy.

Hürthle Cell Tumors of Thyroid Gland. Report on 25 Cases. V. E. Chesky, W. C. Dreese and C. A. Hellwig[5] (Hertzler Clinic, Halstead, Kan.) found this type of tumor in over 1 per cent of all surgical specimens of goiters and found that it made up about 5 per cent of all solitary thyroid tumors. All but one patient were females. Toxic symptoms were present in 36 per cent. The tumor itself had no endocrine function, the toxic symptoms being caused by hyperplasia of surrounding thyroid tissue. *Enlarged neck had* been noted for 1 month to 50 years. Eleven patients were treated by bilateral subtotal thyroidectomy; 13 by unilateral lobectomy.

Of the 25 patients 22 (88 per cent) were alive and 20 (80 per cent) without evidence of disease 1½-9 years after

(5) J. Clin. Endocrinol. 11: 1535-1548, December 1951.

surgery. Three patients died of causes other than thyroid tumor. Two patients showed evidence of recurrent tumor four and seven years after operation. Six of the 12 patients followed over five years postoperatively were alive and free from disease.

Removal of the involved lobe is a sufficiently radical procedure in most cases. If the cervical lymph nodes are palpable, removal of them followed by x ray therapy is advised in addition to thyroidectomy. Microscopic evidence of blood vessel invasion cannot be regarded an infallible sign of clinical malignancy. Whether Hürthle cell tumors are benign adenomas or true cancers is still in doubt. Like any other solitary thyroid tumor, they should be removed as soon as detected.

Hürthle Cell Cancer of Thyroid. Review of 40 Cases is presented by Edgar L. Frazell and Benedict J. Duffy, Jr.[6] (Memorial Cancer Center). These cases comprise about 10 per cent of the thyroid cancers seen in 1939-49. In this tumor the distinctive cell is large acidophilic and opaque. Often, the tumors are encapsulated and simulate benign adenomas but in long standing cases infiltration of surrounding structures is not uncommon. In the untreated patient the initial symptoms and physical findings appear to be essentially those associated with benign thyroid adenoma. The disease tends to be localized in the neck for many years. However, widespread invasion of local structures, regional lymph node and distant metastases have been reported.

Surgery offers these patients the best chance of long time survival and possibly of cure. Total removal of a thyroid lobe containing a solitary nodule is much more preferable than subtotal thyroidectomy. When regional lymph node involvement is not present clinically, radical thyroidectomy or neck dissection is contraindicated. Radical neck dissection is advised in recurrent or residual Hürthle cell cancer. Failure to control the disease was evident in most patients given radiation therapy. In prognosis, the most important factor is probably the stage of the disease on hospitalization.

Hyperparathyroidism Due to Diffuse Primary Hyperplasia and Hypertrophy of Parathyroid Glands. Report of Case. Arthur W. Robinson, B. Marden Black, Randall G.

(6) Cancer 4 952-958 September 1951.

Sprague and Jan H. Tillisch[7] describe their experience

Man, 45, with a two year history of headache, generalized aching, lassitude weakness and dizziness had been treated earlier for peptic ulcer Examination revealed blood pressure 140/105, chronic hyper tensive sclerosis in retinal arteries, a palpable small nodule near the inferior pole of the right lobe of the thyroid, and moderate tenderness in many of the joints. X ray studies showed osteitis fibrosa cystica, duodenal ulcer and normal kidneys. Blood calcium content was 17 mg., inorganic phosphorus 3 4 mg., total protein 7 4 Gm., alkaline phosphatase 4.4 Bodansky units, blood urea nitrogen 78 mg and creatinine 3.1 mg On a calculated calcium intake of 126 mg /24 hours the patient excreted 412 mg calcium.

Surgery disclosed greatly enlarged parathyroid glands and 30.5 Gm. parathyroid tissue was removed the left inferior parathyroid gland, weighing about 50 mg., was left Primary hypertrophy and hyperplasia of the water-clear cells were histopathologically diag nosed. Postoperatively serum calcium content was 5.9 mg and the patient had both Trousseau's and Chvostek's signs and paresthesias. Two drachms of calcium lactate was given three times daily Blood urea nitrogen level rose to 154 mg after surgery, then dropped to 86 mg Fatigue, lethargy, muscular pains and anorexia were allevi ated.

Nine months later blood calcium content was 10 mg., phosphorus 3.1 mg and renal insufficiency persisted. No attempt was made to check parathyroid function by withdrawing calcium lactate and calciferol treatment

Continued renal insufficiency emphasizes the importance of early diagnosis and treatment of hyperparathyroidism. Tetany after subtotal parathyroidectomy may have resulted from inadequate function or atrophy of the parathyroid tissue remnant or a temporary condition caused by avidity of the decalcified skeleton for calcium That parathyroid insufficiency may not be permanent is suggested by normal serum calcium and phosphorus values found after operation, despite treatment with small amounts of calcium lactate and calciferol. There is a high incidence of duodenal ulcer in hyperparathyroid patients.

Primary Hyperplasia of Parathyroid Glands Report of Case with Coincident Duodenal Ulcer is presented by Hollis L. Albright (Boston Univ) and Richard C Kerr[8] (Massa chusetts Memorial Hosp)

Man, 48, had had recurrent renal stones for 20 years. He had been treated twice before for maxillary bone cysts, diagnosed as giant cell tumors. Two months before, when hospitalized elsewhere

(7) Proc. Staff Meet., Mayo Clin. 26 441-446 No 21 1951
(8) J A. M. A. 148 1218-1221 Apr 5 1952.

for massive hematemesis, deformed duodenal cap and small ulcer crater were demonstrated roentgenographically Pyelogram showed a staghorn calculus in the upper calix and mild hydronephrosis of the right kidney When again hospitalized no tumor could be felt in the neck Serum calcium was 12.8 mg./100 cc., phosphorus 2.5 mg./100 cc. and alkaline phosphatase level was 4 Bodansky units. He was anemic and nonprotein nitrogen ranged from 41 to 50 mg./100 ml Urine showed a 1 plus reaction on the Sulkowitch test, albumin 1+ and many white and red cells. Roentgenograms of skull, ribs and pelvis revealed no other bony abnormalities. At surgery an oblong parathyroid tumor was removed from behind the right

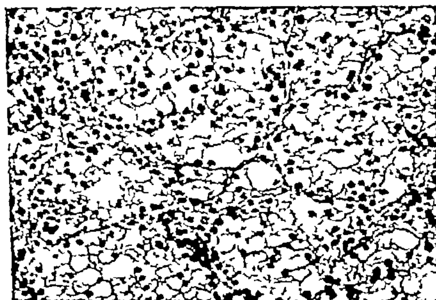


Fig. 37.—Water-clear cells, in primary hyperplasia of parathyroid, are in great preponderance. Note typically thin cell membrane with scantily stained cytoplasm and basilar orientation of nuclei. (Courtesy of Albright, H. L. and Kerr R. O.: J. A. M. A. 148:1218-1221 Apr 5 1952.)

lower pole of the thyroid a similar tumor was found and removed on the left Total weight of removed tissue was nearly 25 Gm Microscopically the sections showed water-clear cells in great preponderance (Fig 37) Primary hyperplasia of parathyroid glands was diagnosed. He did well in the immediate postoperative period, with calcium and phosphorus values within normal limits. He was reported to have had a heart attack four months later Hypertension and ulcer symptoms persisted. Another massive hematemesis caused death 19 months after surgery

Since primary hyperplasia of parathyroid glands was recognized as cause of hyperparathyroidism, 28 cases have been reported They are distinct from parathyroid hyperplasia secondary to renal disease In four cases there were

proved duodenal ulcers and in three others, upper digestive symptoms. Excessive ingestion of calcium and phosphorus in milk and antacids has been suspected of disturbing metabolism of these substances in parathyroid hyperplasia, but evidence is not confirmatory Milk and alkaline powders given patients with duodenal ulcers and hyperparathyroidism may precipitate parathyroid poisoning with nausea and vomiting, lethargy, prostration and possibly fatal azotemia. In patients under ulcer treatment, unless x ray shows gastric retention, intractable vomiting should suggest hypercalcemia

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BREAST

Incidence of Chronic Cystic Disease in So-called Normal Breasts Study Based on 225 Postmortem Examinations is presented by Virginia Kneeland Frantz, John W Pickren, George W Melcher and Hugh Auchincloss Jr[1] (Columbia Univ) A low incidence was found (see table)

PERCENTAGE INCIDENCE ACCORDING TO AGE GROUPS

Finding	Total	Age, Yr.							
		0-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89
Age at death	100	1.1	6.2	13.3	19 1	25.3	19 6	9.5	6.3
Gross cystic dis.	18.6	0.0	21 4	20.0	34 9	15.8	9 1	14.3	22.2
Gross and micro. prolif. cystic dis. and/or apocrine epithel.	52.5	0.0	28.6	60 0	53.5	52.6	50.0	71 4	66.7
Gross and micro. (prolif.) dis.	28.0	0.0	28.6	33.3	39 5	22.8	20.5	33.3	33.3
Microcystic dis. apocrine cells only	24 4	0 0	0.0	26.7	14.0	29 8	29 5	38.1	33.3
Microcystic dis., simple microcysts only	14.7	14.3	21.4	16.7	21.0	10.5	9 1	19 0	11 1
Dilated ducts	24.0	0.0	7 1	6.7	13.9	17 5	47 7	52.4	33.3
Inverted nipples	5.8	14.3	0.0	3.3	0.0	5.3	9 1	9 5	22.2
Secretory cells	3 1	0 0	0 0	3 3	9 3	1.8	0 0	4.8	0 0

Mammary Duct Ectasia Disease That May Simulate Carcinoma The condition is characterized by dilatation of the mammary ducts and fibrosis and inflammation around them according to C D Haagensen[9] (Columbia Univ) It has also been called comedomastitis

Mammary duct ectasia begins with dilatation of the

(1) Cancer 4 762-783 July 1951
(9) Ibid., pp. 749-761

terminal collecting ducts beneath the nipple and areola They become distended with cellular debris and lipoid material. The dilated ducts are bluish and 3-5 mm. in diameter The process generally begins after the menopause, in association with breast involution (average age 55 4) It is usually bilateral. The first symptom is a yellowish or brownish discharge which may become blood tinged. In contrast, intraductal papilloma is characterized by a single dilated duct in which it lies.

The material distending the ducts is amorphous debris which contains characteristic crystalline bodies. It is irritating, causing thickening and shortening of the duct walls by fibrosis and lymphatic infiltration. This in turn produces flattening and retraction of the nipple Atrophy of the epithelium of the involved ducts is also found.

As mammary duct ectasia progresses, continuity of the atrophic duct epithelium is broken in places. The lipid material sets up an inflammatory reaction in the thickened dense, collagenous portion of the duct wall, eventually eroding through the entire thickness of the wall. This leads to an intense inflammatory reaction, like that in fat necrosis following trauma, and phagocytic giant cells surround the lipid material. An abscess may form. In some cases plasma cells predominate, giving the picture of so-called plasma cell mastitis At this stage a firm, palpable tumor is evident, it may be as poorly circumscribed as carcinoma and relatively fixed. Its location near the areolar edge is often diagnostically significant. When fully evolved, the clinical picture is often identical with that of carcinoma. In fact, the preoperative diagnosis in 13 of the 20 cases in this series was carcinoma. The largest tumor was 7×5 cm. Pain, tenderness, redness or edema of the overlying skin suggests that the lesion is not carcinoma, especially when the symptoms are of long duration (five years in one case) and the lesion is bilateral. Axillary nodes may be enlarged as the result of inflammation. Differentiation from carcinoma is impossible grossly Frozen section was found to be diagnostic

Haagensen's experience in neglecting biopsy in some cases, only to discover that the lesion was not carcinomatous led him to the conclusion that it is never safe to perform mastectomy without histologic proof. A 3 cm. incision is made

over the lesion and a 5 mm wedge excised for frozen section If carcinoma is found, a small gauze sponge soaked in Formalin is packed in the wound, after which it is closed tightly with a running suture and sealed with a rubber patch. Radical mastectomy is then done If the lesion is mammary duct ectasia, all abnormal tissue is excised, together with a cone of normal breast tissue, and the wound is closed without drainage

["Never" is a dangerous word to use but anyway there is another convert to the idea that a radical operation should not be performed without a frozen section if there is any doubt about the diagnosis.—Ed.]

Intraductal and Intracystic Papillomas of Breast Spencer T Chester and H Glenn Bell[2] (Univ of California) studied 59 consecutive patients, 44 having nipple discharge as the presenting symptom A lump in the breast was the other common presenting symptom Most had a palpable mass which was usually located centrally i.e all or part of it was within 2 cm. of the edge of the areola Whether or not a mass was present, incidence of nipple discharge on compression of the breast was high. Of the 30 patients on whom simple mastectomy was performed multiple papillomas were found in 12, an incidence of 40 per cent. Incidence of multiple intraductal papillomas in patients treated by local excision was 22 per cent This suggests that intraductal papillomas are left in situ in many patients treated by local excision however only 2 of 20 patients with adequate follow up had recurrence in the same breast, and one of these had a serosanguineous discharge immediately after operation, which indicated that the source of bleeding had not been removed.

Incidence of carcinoma developing later in the patients was 5 per cent, definitely a much higher one than that estimated for the normal population of the same age group for a 10 year period, namely 0 42 per cent. Intraductal papilloma cannot be considered a bilateral disease on the basis of only 2 of 28 patients followed over five years having a similar lesion develop in the opposite breast No carcinoma developed in the same breast after local excision. Local excision with or without a wedge of breast tissue gives essentially the same results as simple mastectomy

( ) West. J Surg. 49 603-609 December 1951

Patients with a serosanguineous nipple discharge but no palpable mass should be treated by simple mastectomy unless the region from which the bleeding arises can be well localized. In such cases the area of breast tissue involved should be removed as a wedge or if this area is large, simple mastectomy may be preferable If in addition there is a palpable mass, this area should be explored, or preferably a wedge of breast tissue including the tumor should be excised for immediate histologic examination. If the excised lesion proves to be malignant radical mastectomy should be done In patients whose symptoms develop after the menopause it would seem advisable to perform simple mastectomy as the initial procedure

Significance of Nipple Discharge William T Fitts, Jr., James D Maxwell and Robert C Horn, Jr [3] (Philadelphia) analyzed clinical and pathologic data relating to 97 female breasts operated on for nipple discharge Papillary proliferation in the ducts (papillomatosis) accounted for the discharge in 47 per cent Solitary papillomas were found only five times This observation indicates that removal of a "solitary papilloma" rarely removes the entire disease Papillomas were demonstrated grossly in only 48 per cent of the cases of papillomatosis Chronic cystic mastitis without proliferative changes was diagnosed in 9 per cent of the breasts and with proliferative changes in 19 per cent. Chronic inflammatory lesions caused the discharge in 13 per cent Although most of the breasts with inflammatory reactions had a nonbloody discharge, three had bloody discharges The type of discharge is therefore not a reliable criterion for diagnosis of the underlying pathologic lesion. The initiating factor in the chronic inflammatory lesions appeared to be duct stasis with accumulation of cellular detritus and much lipoid material

Carcinoma was found in 25 per cent of the breasts. It was associated with a palpable mass in all but two and in both of these Paget's disease of the nipple was present Fifteen carcinomas were intraductal.

From a study of 1,048 breast lesions of all types, it was found that papillomatosis resulted in nipple discharge in

(3) Am. Surg. 134:29 39 July 1951

nearly one third of the breasts in which it was diagnosed, this was also true of chronic inflammatory lesions Only 7 per cent of all carcinomas resulted in a discharge of any kind The incidence of discharge in benign lesions was 11 per cent

A nonbloody discharge does not rule out the possibility of a malignant or premalignant lesion, since the discharge from 9 of the 46 breasts with papillomatosis and 7 of the 24 with carcinoma was nonbloody Average age of patients with benign lesions was 42, and of those with carcinomas,

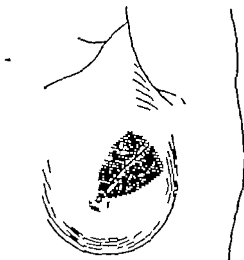


Fig 38 —Incision used to remove involved duct with its tributaries. Shaded area is excised. (Courtesy of Fitts, W T., J et al Ann. Surg. 134 29-39 July 1951.)

54. Seventy per cent of the patients over age 60 had carcinoma.

In most cases the source of the discharge could be localized to a single duct or duct system In such cases resection of that segment of the breast drained by the offending duct or duct system constitutes adequate treatment. A T-shaped incision with the short arm of the T slightly curved and placed within the areola and the long arm extending to the periphery of the breast over the duct segment is made The areolar flap is dissected back to the nipple, and the involved duct or ducts are divided just beneath the nipple With the divided duct as the apex and the periphery of the breast as the base, a pie-shaped wedge of breast tissue is excised (Fig 38) The argument against mastectomy centers on the

psychic effect on the patient of removal of the breast.

Discharge due to carcinoma is usually associated with a mass, which is best managed by excision biopsy for diagnosis followed by radical mastectomy when the diagnosis is confirmed If the involved segment cannot be located preoperatively, if no dominant lump is present, if multiple nipple ducts are involved or if the discharge continues postoperatively, then simple mastectomy should be performed. Regular follow up examinations are essential when a procedure less than mastectomy has been done for nipple discharge

[These figures are in striking contrast to the older dictum that a bloody discharge from the nipple rarely was an accompaniment of carcinoma.—Ed.]

Hereditary Aspect of Breast Cancer in Mother and Daughter Dryden Phelps Morse[4] (Columbia Univ) compared the statistics from 1,844 cases as presented by six different workers with those of 400 control patients as presented by three workers. Incidence of maternal breast cancer was three times as great in the cancer (6 9%) as in the control series (2.3%)

Wassink has found that there is a specific tendency for breast cancer to be inherited. There were 24 patients with breast cancer among 660 whose mothers had breast cancer, and 40 whose mothers had cancer of other sites. There were 43 patients with breast cancer whose sisters had breast cancer as opposed to 16 whose sisters had cancer of other organs Thus, there was an increasing number of breast cancer cases in succeeding generations of breast cancer families

Another line of evidence is that among 660 patients with breast cancer, there were 301 relatives with cancer, 192 of whom were females. In the general population, tumors develop about equally in males and females Furthermore this increased number of female relatives was found to have a preponderance of breast cancers (58%), in contrast with 12% of the comparable female population.

Moreover, breast cancer developed about 10¼ years earlier in the daughter than in the mother This is comparable to Jacobsen's statistics based on death certificate data, according to which breast cancer developed in the daughter nine years earlier That these daughters were more familiar with

(4) Cancer 4:745-746 July 1951

the symptoms of breast cancer and therefore recognized the tumor at an earlier age accounted for only a small fraction of the difference in years noted

Average age of patients with breast cancer associated with other malignant tumors was significantly less than that of the unselected breast cancer patient. Three fourths of the second carcinomas or many more than the expected amount, were in the other breast, uterus or ovary This may be important as evidence that part of the inherited tendency to cancer is caused by an ovarian hormonal imbalance Data on breast feeding in relation to familial breast cancer were equivocal.

Fibroadenomatosis and Carcinoma of Breast. William Kiaer[5] *(Copenhagen) reports that of 322 patients with fibroadenomatosis* of the breast followed for 9-35 years (average 16) 21 were found to have carcinoma In 18 the carcinoma developed in the breast which had been affected with fibroadenomatosis or where the latter had been most pronounced In three cancer developed in the opposite breast. Average age at onset of carcinoma was 47 According to the Danish *Cancer Registry four to five cases of carcinoma would be* expected in the group on a statistical basis.

Of the nonmastectomized patients, 13% were interpreted as having high 30% medium and 57% low grade fibroadenomatosis. Follow up examination showed that 52% with high grade fibroadenomatosis had carcinoma, 8% with medium grade and 3% with low grade

Most of the growths were duct carcinomas showing transitions to carcinomas of the ordinary type or to large cell and rather cell rich carcinomas.

It was concluded that breast cancer is more apt to develop in women with fibroadenomatosis than in others, especially women with high grade, mainly solid intraductal epithelial proliferations. This variety which is most often cystic, occurs predominantly *between ages 35 and 49*

Pain in Carcinoma of Breast. D C Corry[6] (Radcliffe Infirm. Oxford) points out that pain in the breast may be in a swelling or widely distributed in one or both breasts. The significant pains are those localized in a swelling and

(5) Tr North. S. A., pp. 263-285 1951
(6) Lancet 1 274-276 Feb. 9 1952.

they are most commonly noted after the lump is discovered Pain may be momentary or continuous The most characteristic momentary pain is a stabbing one, which may be a single stab or several quick stabs or a pain described as knife like To be significant, the stabbing pain must be in a tumor and not felt vaguely in the breast Another type of momentary pain, found only in breast carcinoma, is the snatching pain, it is described as if the breast had been suddenly pulled out and then let go A continuous pain or ache is seen in both malignant and simple breast diseases A pain which radiates to the other breast is probably due to a simple breast condition. The aching pain in the breast may be made worse by approaching menstruation and relieved by its onset This is especially true of chronic mastitis

Of 204 patients with carcinoma of the breast, 53% had pain In over 30% it was stabbing or snatching A history of two or three stabs of pain in a tumor in rapid succession makes the diagnosis of carcinoma fairly certain. Such pain occurred in 15% of the 204 cases of breast carcinoma and in none of 230 simple breast conditions. A single stab occurred in 15% of the 204 carcinomas, in 6% of 160 cases of chronic mastitis in 3% of 67 fibroadenomas and in about half of a small series of cases of fat necrosis

It was impossible to correlate multiple stabbing pains with the histologic grade of the tumor though there was some suggestion that such pain was commoner in patients with extensive lymph node involvement

Occult Carcinoma of the Breast is often difficult to diagnose because it depends largely on clinical examination Excision of a "dominant lump for gross and microscopic examination is considered the only accurate diagnostic method If biopsy of the lump is delayed until nipple retraction skin and fascial attachment appear cure may be hopeless.

William T Fitts, Jr., and Robert C Horn, Jr [7] (Univ of Pennsylvania) in five years found 16 hospitalized patients with occult breast carcinoma 15 had no palpable breast mass when operated on and in the last, only autopsy showed the breast as the source of wide-spread abdominal metastasis. The only clinical manifestation was, in four each, nipple dis-

(7) J A M A 147 1429 1433 Dec 8 1951

charge, Paget's disease of the nipple and axillary lymph node metastasis. In each of three with lymph node metastasis, only the lymph node initially removed showed metastatic carcinoma, the primary lesion was not discovered in the fourth patient. Two had only distant metastases, one had skin retraction, and one had only skin edema Four of the 16 had bilateral mammary cancer, in 2 of them the occult carcinoma may well have been a metastasis from a previously treated carcinoma of the opposite breast The following are illustrative cases

CASE 1.—Woman, 51, with serous discharge from the right nipple for seven months but with no palpable breast mass, had simple mastectomy A hard, uncircumscribed lesion, proved to be an intraductal carcinoma, was found 4 0 cm. beneath the nipple. At radical mastectomy four days later, several axillary nodes were found to contain metastases. After 20 months the patient noted a left breast lump which, when removed 5 months later, proved to be an anaplastic cancer She died of generalized metastases three years after initial surgery

CASE 8.—Woman, 44, with eight months of itching and redness of left nipple and more recent inversion, had a radical mastectomy Though previously not noted, a mass near the nipple, not fixed to the skin, was palpated just before surgery and found to be an anaplastic tumor invading surrounding breast tissue. Of 40 axillary nodes removed, 27 contained cancer cells.

CASE 9—Woman, 35, two weeks previously had noted a lump preceded by intermittent aching, in the left axilla and radiating to the left breast. Histologic examination of the lump after excision showed mucoid carcinoma within a lymph node. Left radical mastectomy was done despite inability to palpate a mass. An uncircumscribed, hard, 1.0 cm. mucoid carcinoma was discovered deeply buried in the left lower quadrant. The only cancerous axillary lymph node was the one removed for biopsy, 27 others removed at radical mastectomy were free of malignant cells. No recurrence ensued

Bloody or serous nipple discharge (Case 1) not normally *associated with lactation* should be surgically investigated, even when a mass is not palpable a pie shaped segment of breast with the suspected duct as its axis and the periphery of the breast as its base should be excised. *Paget's disease* of the nipple (Case 8) is apparently caused by distal extension of intraductal cancer into the nipple and calls for radical mastectomy *Metastatic carcinoma of axillary* lymph nodes, even when the primary site cannot be discovered by physical examination (Case 9) warrants radical mastectomy

Preclinical Paget's Disease of Nipple Malcolm B Dockerty and Stuart W Harrington[8] (Mayo Clinic) discuss the pathogenesis in seven cases of Paget's disease in which no macroscopic signs of nipple abnormality could be detected, the clinical picture being that of ordinary mammary carcinoma, sometimes of several years' duration There is evidence that the deep glandular carcinoma preceded in point of time the evolution of the cutaneous changes which, although typical of Paget's disease, were found only after careful and prolonged microscopic search The cutaneous origin of the entire malignant process is not entirely ruled out in these patients, but the extremely small size of the intraepidermal component as compared with the large bulk of the deep-lying mammary lesions makes it questionable The autochthonous origin of these cells within the epidermis is not disproved, but the evidence supports more strongly the concept of epidermal metastasis from the deep-lying lesion.

Investigators overemphasize the gross clinical features of the cutaneous component of Paget's disease The cutaneous changes are always accompanied, if not preceded, by development of adenocarcinoma in the underlying breast The "deep" carcinoma tends to be multicentric, and its origin seems to be from the linings of the large ducts. It is important to make a careful search of the nipple tissue for cells typical of Paget's disease

Breast Biopsies Study of Over 400 Cases. Lawrence G Khedroo, Philip A. Casella and Arthur F Cipolla[9] (Chicago) found that an average of one of six masses (in 432 consecutive cases) was malignant Although about 20 per cent of the patients who present themselves with a suspected breast mass will give a history of menstrual, menopausal or other gynecologic disorders, this is not significant Incidence of malignancy is lowest in the young age groups, but the ratio approaches equality in the sixth decade of life In 11 per cent of the benign cases and 18 per cent of the malignant there was a family history of malignancy Of the tumors of mammary tissue origin the four commonest benign ones were in the order of frequency lobular hyperplasia, fibroadenoma lipoma and duct papilloma Incidence

(8) Surg., Gynec. & Obst. 93:317-320 September 1951
(9) Am. J Surg 82:741 745 December 1951

of lipomas was relatively high. The malignant tumors were all carcinomas, scirrhous, comedo or medullary

Frozen section has limitations as a means of diagnosis in breast lesions. Training and experience in pathology enables the surgeon to diagnose about 80 per cent grossly at the time of operation. The remaining questionable lesions are best studied by paraffin section accuracy is more important than a delay of 48-72 hours in applying definitive therapy Use of frozen section can add little more to the percentage because of limitations imposed by thickness of the section, size of the tissue which can be adequately cut in a frozen state by microtome and less than ideal absorption of tissue stains This relegates the frozen section to the background as an accurate means of early diagnosis but it does not lose its place as an excellent teaching method for breast pathology

[Many pathologists would not agree with this conclusion. Certainly there should seldom be any difficulty about getting a piece of tissue of the proper size.—Ed.]

Prophylaxis of Postmammectomy Lymphedema by Use of Gelfoam Laminated Rolls Preliminary Report with Review of Theories on Etiology of Elephantiasis Chirurgica and Summary of Previous Operations for Its Control is presented by *Norman Treves*[1] *(Memorial Hosp., New York City)* The following states may cause postmammectomy brawny arm (1) postmammectomy lymphedema as an operative sequel (2) prolonged postoperative drainage (3) cutaneous or axillary infection (4) infections from sloughs of skin margins, (5) lymphangitis and cellulitis recurring after primary healing (6) cicatrix of axilla (7) angulation of the axillary vein, (8) occlusion of the axillary or subclavian vein (9) cutaneous and/or subdermal fibrosis from irradiation or infection (10) reflex blood vessel spasm (11) nerve alteration through fibrosis of the brachial plexus or parasympathetic ablation, and/or (12) obesity A serious complication of brawny arm is supervening malignancy in the form of lymphangiosarcoma, which is more fatal than breast cancer Prevention of brawny arm is important since its treatment has thus far been unsatisfactory Gelfoam is used to (1) prevent angulation of the vein by splinting to oblit

(1) Cancer 5 73 84 January 1952

erate axillary dead space, (2) prevent cicatrization around remaining axillary structures and (3) act as a bridge across which new lymphatics grow. If fibrosis should develop it should increase the lumen of the vessels by horizontal traction instead of causing constriction.

TECHNIC.—On completion of hemostasis and insertion of drains after radical mastectomy, three or four 12 cm. × 8 mm. unmoistened Gelfoam strips are placed superior anterior and inferior to the exposed nerve, artery and vein (Fig. 39) from the sternoclavicular ligament mesially to an area in the arm opposite the teres major

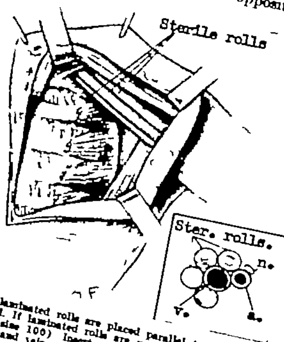


Fig. 39.—Gelfoam laminated rolls are placed parallel to blood vessels and nerves. Three or four are used. If laminated rolls are unavailable, Gelfoam cigaret rolls are made from the sheet (size 100). Insert: schematic cross section to show relation of rolls to nerves, artery and vein. (Courtesy of Treves, V.: Cancer 5:73-84, January 1952.)

muscle insertion and adjacent fossa where the profunda lymphatic branches have been avulsed.

This procedure was used in 84 consecutive radical mastectomies or radical axillary dissections. Drainage has not increased nor have rolls been discharged through drainage tracts, although in one patient two unabsorbed Gelfoam rolls bulged slightly at the level of the fourth rib six weeks after radical mastectomy and were removed through a small incision without further complication. In 87% of patients, no postoperative swelling of the arm or massive edema appeared. Autopsy on one patient with disseminated cancer

22 months after operation, showed that the Gelfoam had been completely absorbed with no unusual axillary scarring, and lymphatic regeneration was evident.

Methylandrostenediol in Palliative Treatment of Breast Cancer S C Kasdon, W H. Fishman, R. M. Dart, C D Bonner and F Homburger[3] (Boston) gave methylandrostenediol for varying periods and by different routes to 44 patients with inoperable advanced cancer of the breast. The dosage schedule was 25 mg six times a week for patients receiving oil suspensions, 100 mg three times a week for ambulatory patients given aqueous suspensions, and 100 mg seven times a week for hospitalized patients. Pellets of 150-300 mg were given to some at one, two and four week intervals Oral medication was given in 100 150 200 and 300 mg daily doses

Thirty patients showed improvement, whereas 14 showed no change in the *progressive course of the disease* Eight of nine patients with objective as well as subjective improvement were past the menopause and had a reasonably comfortable remission for 3 weeks to 19 months Although some metastases showed objective improvement, others might continue to grow Twenty-one patients had subjective improvement only, ranging from increased well being to euphoria. It lasted as long as six months but progressive tumor growth continued.

Undesirable side-effects, in order of decreasing gravity were (1) hypercalcemia, three patients (2) hirsutism, three (3) increased libido, two and (4) acne, three No patient had signs of congestion and edema.

The favorable effects in the first month of therapy with methylandrostenediol occur more slowly than in a comparable period of testosterone therapy, but after this period results are similar in degree to improvement induced with testosterone It is not possible to draw conclusions as to the optimal dose or preferred route of administration All modes of administration appear capable of producing some desirable effects. Neither is it possible to draw any conclusions as to the effectiveness of methylandrostenediol on the basis of the type of metastasis

(3) J A. M. A. 148 1212 1216 Apr 5 1952.

Multiple Rib Fractures Indication for Tracheotomy Mark H. Williams[3] (Binghamton, N Y., City Hosp) states that a formidable group of pleural, pulmonary, cardiac and cardiorespiratory complications are common occurrences in patients with multiple rib fractures There is always a problem of keeping the tracheobronchial tree clear of blood and secretions. The pattern is definite in the average patient in whom pulmonary complications develop due to accumulation of tracheobronchial secretions The patient's condition is good at hospitalization Within 24-48 hours tracheobronchial secretions accumulate to require oxygen, 12-24 hours after this a severe complication of pneumonia and atelectasis has developed. Cough in these patients is impaired by pain and fear of pain, dyspnea due to pleural or pulmonary complications, paradoxical movement of chest wall, morphine narcosis, cerebral anoxia and shock. Some patients are unwilling or unable to cough. In patients unwilling to cough, effective coughing can be established by application of elastic bandages, judicious use of narcotics and intercostal nerve block Tracheal suction or bronchoscopic aspirations will be required in patients unable to cough Tracheotomy should be done in those unable to cough as soon as it is seen that the tracheobronchial tree cannot be kept clear of secretions by alternative methods. The operation provides an absolutely dependable method of clearing the tracheobronchial tree at any hour and at an instant's notice, it also allows the intratracheal administration of oxygen and penicillin.

Tracheotomy was done in four patients with immediate and outstanding benefits, all recovered. Pulmonary complications did not develop in two patients operated on early, bilateral pneumonia present in two patients at tracheotomy resolved after operation. In one patient severe paradoxical movement of the sternum and attached anterior rib fragments occurred during cough and tracheobronchial secretions accumulated, causing bronchial obstruction and anoxemia this in turn produced labored breathing and increased

(3) Surgery 30:664-673 October 1951

the pain and paradoxical chest wall movement. This cycle was broken by thorough tracheal suction after tracheotomy One patient with a severe pneumothorax improved remark ably after tracheotomy

[Tracheotomy has long been a useful procedure to assist a patient to get rid of troublesome secretions. Evidently some chest surgeons are just be ginning to rediscover it.—Ed.]

Chronic Abscesses and Sinuses of Chest Wall Treatment of Costal Chondritis and Sternal Osteomyelitis is discussed by Robert B Brown and John Trenton[4] (U S Naval Hosp., Philadelphia) on the basis of nine cases of primary infection within the chest wall or adjacent mediastinum or of lesion limited entirely to these structures In eight, the lesions were tuberculous in origin although superimposed pyogenic infection sometimes made this difficult to prove In tuber culous patients chondritis was probably secondary to infec tion of mediastinal lymph nodes and tuberculous nodes were excised from several patients. These chronic thoracic infec tions, despite their original nature usually develop as costal or sternal chondritis or osteomyelitis.

Adequate surgery will clear up these infections. All in volved cartilage must be resected subperichondrially As the 6th 10th costal cartilages are fused, involvement of any one of them indicates resection of the entire costal arch Avascular hyaline cartilage when exposed in an infected wound, becomes necrotic, acts as a foreign body and pro duces a persistent sinus Limited resection, even when the cleanly divided cartilaginous end is meticulously covered with perichondrium and muscle fails to prevent sinus for mation. However sternal osteomyelitis may be treated by resecting only the infected portion of bone If together with this, all extensions of the infection in the soft tissues are carefully excised, primary closure may be performed Prompt healing usually ensues Antibiotics and chemother apy are adjuncts to surgery Tuberculous patients are given streptomycin for 30-60 days postoperatively

In one patient infection spread from one costal arch to the other through the cartilage of the xiphoid process and required bilateral removal of the costal arches and xiphoid process. In the nontuberculous patient, the cartilaginous

(4) Am. Surg 135 44 51 January 1952

right costal arch was involved by spread of pyogenic infection from a subphrenic abscess drainage tract. He was treated by inadequate excision and healed only after all exposed cartilage was resected All nine patients were well after adequate surgery during follow up of several months to two years.

[These principles of treating infections of the costal cartilages were expressed by Dr Alexis V Moschowitz of New York about the year 1915. They are still good.—Ed.]

Tietze s Syndrome Catharina Brun and A. H. Smook[5] discuss 11 cases The condition is more commonly found in women, perhaps because of their greater concern with mammary carcinoma and cosmetic effects. It consists of a painful, nonsuppurative swelling of the cartilaginous portion of the ribs, often one of the upper four The overlying skin is not red, warm or attached to the tumor Pain is noted especially on coughing and stooping, and with pressure Careful palpation reveals fusiform swelling of the cartilage although the bone is normal There is no regional adenopathy No specific changes except some osseous metaplasia, are observed on biopsy The cause is unknown

Nine of the 11 patients were women. They were aged 20-70, half were over 50 All became suddenly aware of the tumor e g by experiencing pain on coughing Chest x rays were negative and the cartilaginous tumor was not observable on the films. Laboratory examinations were negative except for increased sedimentation rate in one patient On follow up examination 9-54 months later the condition of all patients was unchanged All had observed more difficulty when fatigued and one had noted increased pain during menses Only one requested treatment at that time, and he was given roentgen therapy

Neurogenous Tumors within Thorax Clinicopathologic Evaluation of 48 Cases Lauren V Ackerman and Frederick H Taylor[6] (Washington Univ) classify such tumors as follows. (1) Tumors which arise from the nerve cells of the sympathetic nervous system are ganglioneuroma (well differentiated), ganglioneuroblastoma (moderately well differentiated) and neuroblastoma (poorly differentiated) (2) Tumors of nerve sheath origin are neurilemmoma, ancient

(5) Nederl. tijdschr verlosk. en gynaec. 95:2605 2608 Sept. 8 1951
(6) Cancer 4:669-691 July 1951

(f) neurilemmoma, neurofibroma and malignant schwannoma (neurofibrosarcoma) In general, symptoms are due to compression. Presence of hoarseness due to compression of the laryngeal nerve or of Horner's syndrome does not necessarily indicate malignancy Malignancy is a likely possibility, however, in the presence of obvious Recklinghausen's disease In this series, all patients with malignant tumor had symptoms such as pain, paresthesias, anesthesias and/or weakness of the arms.

The x ray shadow cast by this tumor does not aid differentiation of the type or determination of the presence of malignancy Indeed, other neoplasms have a similar x ray appearance However, if there is ragged bone destruction locally and distantly, a malignant tumor is indicated. Location of the neuroblastoma as a discrete tumor situated superiorly in the posterior mediastinum does aid in arousing suspicion of presence of the tumor In one case aspiration *biopsy of a large posterior mediastinal tumor enabled diagnosis* of neurogenic tumor in a patient who refused surgery

Surgical removal is indicated for the entire group of neurogenous tumors, especially since it cannot be predicted which tumors are malignant. The only possible exception is neuroblastoma which is extremely radiosensitive. Even in the presence of liver metastases complete sterilization of a neuroblastoma has been accomplished by small amounts of radiation.

Prognosis in cases of tumors of the nerve cells of the sympathetic nervous system depends on the degree of microscopic differentiation Neuroblastomas have a poor prognosis (all three patients died although one lived 2½ years after tumor removal) Ganglioneuroblastomas have a poor prognosis, but an occasional patient is cured (three of seven) Ganglioneuromas have an excellent outlook (all seven patients were living and well)

With regard to tumors of nerve sheath origin, there were 10 patients with neurilemmoma, 10 with questionable ancient neurilemmoma and 7 with neurofibroma. In all, prognosis was excellent despite the fact that one patient with neurofibroma also showed evidence of Recklinghausen's disease Of the 27 patients, 26 were living and well without evidence of disease Of four patients with malignant tumor of nerve

sheath origin, three were dead and one was alive without evidence of disease The tendency to overestimate malignancy because of the great cellularity in tumors of schwannian sheath origin must be guarded against.

[Thoracic neurogenic tumors nearly always arise in the posterior mediastinum or from the posterior chest wall.—Ed.]

Surgical Management of Traumatic Chylothorax is evaluated by Harris B Shumacker, Jr., and Thomas C Moore[7] (Indiana Univ) Nontraumatic chylothorax is almost invariably fatal, with or without surgery Traumatic chylothorax is reportedly 50% fatal without operation, in contrast to the uniformly successful outcome in three recently reported cases and two described by the authors.

Boy, aged 4½ months, with tetralogy of Fallot, had an end to-side subclavian pulmonary artery anastomosis performed without visualization of the thoracic duct or chylous fluid. Thirteen days later, rapidly progressive cyanosis and dyspnea set in due to right chylothorax. Thoracenteses yielded 205, 180, and 265 cc. chylous fluid on three successive days. Re-exploration was done 17 days after the original operation. Four hours before, he was given 90 cc. cream by mouth. Chylous leak was observed from a small opening in the mediastinal pleura about 1.5 cm. superior to the aortic arch where the subclavian artery had previously been. Since enlargement of this opening did not serve to identify the duct, the leak was stopped by the placing of no 00000 transfixing ligatures along the margins and packing Gelfoam into the area by ligating over it the previously placed sutures. Subsequent x rays showed no reaccumulation of fluid. Steady improvement followed during three months' observation.

Death from traumatic chylothorax usually is due to inanition when asphyxia from mechanical compression is prevented by thoracentesis or closed drainage Treatment is directed toward relief of compression, maintenance of nutrition and measures to halt loss of chylous fluid Although a low fat diet may lessen the amount of chyle loss of chyle presents an increasingly serious nutritional problem until manition makes the patient a poor surgical risk. Intravenous administration of chyle is too hazardous for general application. Efforts to treat traumatic chylothorax by collapse methods have proved unsuccessful. The thoracic duct can be ligated with impunity owing to numerous collateral communications with the lumbar intercostal and azygos veins.

The operation is facilitated by giving cream by month several hours before operation since this increases the chy

(7) Surg Gynec. & Obst. 93 46 50 July 1951

lous leak from the point of leakage Further experiences will help decide whether it is better to ligate the point of injury or to attempt treatment by ligating the duct proximally just above the diaphragm.

LUNG

Bronchial Arteries II. Their Role in Pulmonary Embolism and Infarction was evaluated in dogs by F Henry Ellis, Jr., John H. Grindlay and Jesse E Edwards[8] (Mayo Clinic and Found) The prevailing opinion appears to be that bronchial arterial circulation is essential to normal lung nutrition and that the dilatation of the bronchial arteries that follows pulmonary embolism meets the nutrient requirements of pulmonary tissue distal to an embolus

In all dogs the bronchial artery to the right apical lobe was occluded In one group a pulmonary embolism was produced 10-14 days later by introduction of glass beads into the right jugular vein. In the second group one or both branches of the pulmonary artery to the right apical lobe were divided. In a third group a pulmonary embolism was produced with glass beads two weeks after occlusion and was followed promptly by operative constriction of the pulmonary veins of both apical lobes by ligation with linen, leaving a lumen of 2 5 mm. The dogs were subsequently killed at varying intervals and the lungs studied.

In the first group of dogs no pathologic changes were found in the right apical lobe which had been deprived of its bronchial arterial circulation and in which no collateral systemic circulation had developed. In the other lobes with intact and dilated bronchial arteries, zones of hemorrhage and edema resembling the incomplete infarcts of Hampton and Castleman occurred, and when sufficient emboli were present true pulmonary infarcts were encountered In one of two dogs in which both branches of the pulmonary artery to the right apical lobe were divided gangrene developed. In the other collateral systemic arteries to the right apical lobe were present and examination showed

(8) Surgery 31 167 179 February 1952

early healing of extensive infarction. However, when only one of the two branches of the pulmonary artery were divided no significant changes were seen in the right apical lobe In the third group it was found that infarction occurs in lobes containing emboli when pulmonary venous congestion is present, regardless of the presence or absence of intact bronchial arterial circulation There was no difference in the extent of infarction in both apical lobes, the left having an intact bronchial arterial circulation and the right no such circulation (or negligible collateral systemic blood supply)

It appears that pulmonary capillary anastomoses effectively prevent pulmonary infarction after pulmonary embolism and that bronchial arterial circulation is not necessary for this purpose The role of the pulmonary capillary anastomoses is further evidenced by the experiment in which gangrene of the lobe occurred when the entire pulmonary arterial blood supply was interrupted but not when only one of the two pulmonary arterial branches was divided. The bronchial circulation seems to be the main source of hemorrhage distal to a pulmonary embolus, the high pressure system emptying into a low pressure area which is already subject to vascular alterations through ischemia, with resultant intra alveolar hemorrhage and edema Intact and dilating bronchial arterial circulation may thus contribute to development of infarcts after pulmonary embolism, but the bronchial circulation is not essential for development of pulmonary infarction when pulmonary congestion is severe

Prevention and Treatment of Atelectasis by Control of Bronchial Secretions are discussed by John M Baker L C Roettig and George M Curtis[9] (Ohio State Univ) Postoperative pulmonary atelectasis is produced by retention of highly viscous secretions which occlude bronchi with subsequent absorption of air from the segment involved The bronchial secretions which are elaborated by the goblet cells and bronchial glands, which secrete both mucin and serous fluid, are removed by ciliary action, cough mechanism, lymphatic absorption and respiratory movements. The normal bronchial secretion forms a two layer covering for the mu

(9) Ann Surg 134 641-64 October 1951

cosa, the outer layer being a mucus blanket which is tenacious but not extremely viscid and an underlying layer which is a serous coating In the presence of chronic irritation, inflammation or allergy, production of mucin is increased, the cilia become entangled and the basis for atelectasis is prepared Clearance of the bronchial tree is dependent on maintenance of normal bronchial secretory activity Postoperative atelectasis occurs in persons who have an altered bronchial secretion which is highly viscid and contains increased mucin

Experimental data show that iodide given intravenously concentrates in the mucosa and submucosa of the bronchi and bronchioles and then rapidly passes into the bronchial lumen. The maximal concentration of iodine in the bronchial mucosa occurs in 10 minutes as shown by histochemical methods There is a great increase in fluid volume, which occurs as the maximal concentration of iodide passes into the bronchial lumen. An increase in bronchial secretions can be seen by bronchoscopy By histochemical methods the iodides are seen to pass rapidly across the respiratory tract mucosa, a process which carries water with it across the semipermeable membrane by osmotic activity This directly provides the cilia with a serous fluid layer in which to beat, and again they can become more effective Decreased viscosity of the secretion aids the cough mechanism and evacuation by respiratory movements.

Sodium iodide, 1 2 Gm twice daily, was given intravenously to 11 patients with postoperative atelectasis for three to four days. In 10 atelectasis cleared within 24 hours and in 1 in 48 hours To prevent atelectasis, 100 consecutive surgical patients were given 1 Gm. sodium iodide intravenously twice daily for three to four days postoperatively They were encouraged to cough 15 minutes after administration, since this is the point of maximal secretory effect. Atelectasis or pneumonia did not develop in any patient. There were no cases of iodine sensitivity

Function Tests in Pulmonary Surgery G Birath and C. Crafoord[1] (Stockholm) point out the necessity of accurate evaluation of pulmonary function in pulmonary surgery Respiratory function is a complicated process involving

(1) J Thoracic Surg. 22 414 423 October 1951

heart, lungs, blood and tissues, tests of function may evaluate all the participating factors by exercise tests or the elementary functions can be evaluated Dyspnea in chest patients is almost invariably of cardiac or pulmonary origin and the routine methods of investigation must be used to rule out the cardiac origin

Following are some causes of pulmonary dyspnea (1) Ventilation insufficiency may be produced by obstruction of any kind in the air passages, e g, tuberculous strictures, tumors, enlarged bronchial glands and by impairment of costal and diaphragmatic mobility Overlapping from this group into the next is enlargement of respiratory dead space by bronchiectasis, pulmonary emphysema etc., which often produce severe dyspnea. (2) Parenchymatous insufficiency occurs when the size of the functioning area has been reduced (*a*) quantitatively by disease, collapse procedures or extirpation of lung tissue (*b*) qualitatively, by impaired diffusion of gases through the alveolar membrane due to toxic agents or stasis (3) Insufficiency of the pulmonary circulation may be brought about by (*a*) persistent circulation through unventilated parts of the lung so that unoxygenated blood is mixed with arterial blood (*b*) arteriovenous aneurysm (*c*) obstruction of the pulmonary artery by emboli or obliterative arteritis.

Fluoroscopic and radiologic investigation of the costal and diaphragmatic movements is of great value Impairment of diaphragmatic mobility by intrapleural adhesions has an especially deleterious effect on ventilatory function it is the commonest cause of ventilation insufficiency dyspnea. A rough estimate of ventilation capacity on either side can be made by fluoroscopic study during forced breathing The registration of the maximal diaphragmatic movements by double exposure on the same film is very useful.

Estimation of the total lung volume and its subdivisions is important. The indications for surgical intervention should not be bound to fixed values of the vital or total capacities Estimation should be based on the percentage values of residual and functional residual air Good vital capacity with increased residual capacity indicated madequate rather than efficient function. Low vital capacity but normal percentage of residual air often permits pulmonary

surgery In emphysema the vital capacity is often good but the residual air, which in normal persons is 25% of the total lung volume, is increased to 50% Other ventilation impairing conditions such as bronchostenosis, bronchiectasis, indurated or infiltrated parenchyma and extensive adhesions may cause a disproportionate increase in the residual air

If pulmonary and/or pleural anomalies are present bilaterally, it may be impossible to decide by these tests which lung has the better function. The function of each lung can be investigated separately by bronchospirometry Should function of the lung requiring surgical treatment be the better surgery may be omitted. If the reverse is true, surgery may be performed with confidence The main indication for bronchospirometry is limitation of function by bilateral disease, most commonly tuberculosis In judging the results of bronchospirometry it is necessary to remember the larger size and greater ventilation and oxygen consumption of the right lung Complications arising from bronchospirometry are rare and completely avoidable

In diseases affecting the pulmonary blood vessels the area of the pulmonary vascular bed is reduced and the pressure in the minor circulation consequently increased If the strain on the right heart becomes excessive, right cardiac insufficiency develops with its characteristic dyspneic attacks often in the almost complete absence of other symptoms of cardiac failure To avoid this right cardiac involvement preoperative registration of the pressure in the right pulmonary artery is obtained by heart catheterization The fullest information can be obtained if some form of graded exercise is undertaken during the test so that pressure reaction may be observed

Progressive Changes in Pulmonary Function after Pneumonectomy Influence of Thoracoplasty, Pneumothorax, Oleothorax and Plastic Sponge Plombage on Side of Pneumonectomy Edward A. Gaensler and John W Strieder[2] (Boston City Hosp) studied 40 postpneumonectomy patients to gain an understanding of development of functional defects of the remaining lung and to determine ideal conditions for functional preservation of it. Mainly they were concerned with the type and amount of overdistention and pro-

(2) J Thoracic Surg 22 1-34 July 1951

cedures which might modify such changes Before operation bronchospirometric studies were made of oxygen uptake, ventilation vital capacity residual volume total lung capacity and pulmonary mixing indices for the two lungs separately Thus the state of overdistention of the remaining lung could be established before surgery

Thirty five of the 40 patients were operated on for tuberculosis Patients with primary and metastatic tumors were excluded Thirty nine were followed 6 months to 2¼ years Nine patients had additional collapse therapy of the remaining lung No patient had significant disease of the remaining lung from a functional standpoint before or after operation.

The various means of treating the pneumonectomized side to minimize distention of the remaining lung were compared. It was concluded that some overdistention of the remaining lung cannot be avoided if the empty hemithorax is not treated. Severity of this overdistention is unpredictable before operation A prosthesis of oil, plastic sponge or air under slightly positive pressure obviated entirely overdistention and mediastinal shift and furthermore caused no loss of maximal ventilatory function. Thoracoplasty was less beneficial If performed early thoracoplasty caused a definite additional loss of maximal ventilation although it prevented overdistention. If performed late it caused only partial return of the opposite lung to its normal confines and also produced further loss of pulmonary function.

If overdistention is undesirable then pneumothorax later followed by plastic sponge plombage is the ideal answer The problem, however cannot be so isolated From the surgical viewpoint exposure of tuberculous mediastinal nodes and the bronchial stump to an air filled cavity the possibility of empyema and the introduction of a large foreign body the plastic sponge cannot appear very attractive These deterring considerations would be considered most carefully in the tuberculous patient but might be of little significance in malignant neoplastic disease of the lung

Studies in young patients, made for 2½ years after operation, did not indicate that overdistention of the lung following pneumonectomy leads to true emphysema with disruption of the pulmonary parenchymal architecture In older patients progression of true emphysema was shown

Pulmonary Function in Traumatic Hemothorax Treated by Decortication. James H. Forsee, Stephen L. Kylar and Hu A. Blake[3] (Fitzsimons Army Hosp, Denver) studied 19 patients with traumatic hemothorax secondary to war wounds before operation and up to five months afterward. The patients were young adults who had been in good health previously, and all underwent decortication early The rationale of decortication is the release of a lung imprisoned by a membrane formed as a result of organized blood and fluid in the pleural space By removal of this membrane the pulmonary volume, which is reduced, is expected to increase

Maximal breathing capacity was selected as a test of function because it is considered a most effective measurement of the bellows action of the chest, the patient's potential response to exertional stress and respiratory reserve It was increased postoperatively in 16 patients (average 21 L.), decreased in 5 (average 15 L) and unchanged in 1. Bronchospirometry, which permits divided functional studies of each lung to be made at the same time, gave appreciable pre and postoperative variations in these patients. Vital capacity increased postoperatively on the operated side in 11 and decreased or remained the same in 6 Oxygen consumption increased on the operated side in 14 and decreased in 5 Only two showed decreased ventilation postoperatively on the injured side, and this was slight.

Since the studies were made relatively soon after operation, additional ones made after a longer interval might alter the observations The fact that improvement was variable or nonexistent may be due to the short observation period The little difference between pre- and postoperative values may be due to the patients' youthfulness and the short time that the lung was encased by the "peel."

[Regardless of what the tests show decortication must increase the functional capacity of the lung provided that it is still expansile.—Ed.]

Lung Function Studies in Poudrage Treatment of Recurrent Spontaneous Pneumothorax. Exploratory thoracotomy followed by resection of pulmonary cysts, blebs or bullae, with or without talcum poudrage to induce pleuritis seems to be the preferred method of treatment for recurrent

(3) J Thoracic Surg. 22 38-44 July 1951.

spontaneous pneumothorax. John S Paul, E J Beattie, Jr., and Brian Blades[4] (Washington, D C) carried out pulmonary function studies by means of bronchospirometry on four patients treated by thoracotomy and talcum poudrage to determine whether the latter has any damaging effects Operation was on the left side in three and bilateral in one

In one patient vital capacity fell 3% after poudrage Relative vital capacity of the left lung fell 2% relative minute ventilation of the left lung fell 6% and oxygen consumption of the left side rose 5%

Vital capacity of the second patient fell 18% after bilateral operation. After operation on the left side alone, relative vital capacity of the left lung rose 2% relative minute ventilation fell 7% and oxygen consumption fell 4% After operation on the right side, relative vital capacity of the right lung fell 7%, relative minute ventilation rose 11% and oxygen consumption fell 30% The fall of oxygen consumption on the right side seems significant.

In the third patient vital capacity fell 13% after poudrage Relative vital capacity of the left lung rose 8%, relative minute ventilation of the left lung rose 6% and oxygen consumption of the left side rose 29% The increase in oxygen consumption seems significant

In the fourth patient vital capacity fell 3% after poudrage Relative vital capacity of the left lung rose 1% relative minute ventilation of the left lung rose 19% and oxygen consumption of the left side was unchanged. The increase in minute ventilation on the left side seems significant

There was no consistent decrease in pulmonary function. The changes did not appear to be of greater degree than would be expected after any open thoracotomy It is concluded that introduction of talcum powder to induce pleural symphysis has no demonstrable harmful effects

Late Changes in Ventilatory Function Following Thoracoplasty Samuel R Powers, Jr., and Aaron Himmelstein[5] (Columbia Univ) noted increasing respiratory distress in some post thoracoplasty patients, despite excellent therapeutic results. All showed rotoscoliosis. The factors affecting

(4) J Thoracic Surg. 22 52-58 July 1951.
(5) Ibid., pp. 45-51.

the ventilatory function of the patients were analyzed. Scoliosis, as seen on roentgenograms, was invariably accompanied by significant loss of ventilatory function, as measured by vital or maximal breathing capacity tests. Removal of the first rib together with the long anterior segments of the second, third and fourth ribs and transverse processes was usually associated with appearance of the deformity. Preservation of the long anterior segments seemed most important in limiting deformity. Since most tuberculous lesions occur in the posterior and apical segments of the lung it may seem advisable to do a less radical anterior thoracoplasty in appropriate cases and thus prevent the rotoscoliosis and diminished ventilatory function. More accurate localization of lesions will minimize the need for extensive rib resections. An alternative procedure may be pulmonary resection combined with more limited thoracoplasty. The mechanism of the scoliosis is thought to be the unopposed pull of the muscle groups on the intact side after detachment of the muscles on the operated side. Some patients were observed in whom rotoscoliosis did not occur even though extensive thoracoplasty of the type described had been performed.

Some Questions about Bronchogenic Carcinoma. Evarts A. Graham[6] (Washington Univ.) points out the greatly increased incidence of this disease as proved by reports from England, Wales and the United States. In contrast, incidence of carcinoma of the stomach seems to be almost stationary. Evidence indicates strongly that cigaret smoking, especially excessive smoking for 20 or more years, is an important causative factor. Of 605 men with lung cancer, 51.2% were "excessive" or "chain" smokers as compared with only 19.1% in a control series of 780 patients of corresponding ages who did not have bronchogenic cancer. Only 2% of the men with bronchogenic cancer were nonsmokers. Bronchogenic carcinoma is observed far less often in women than in men. The relation of cigaret smoking to lung cancer is not weakened by this lowered incidence in women, for women smoke much less and have smoked for a shorter time. Most female heavy smokers are young women who have begun to smoke rather recently. The studies of

(6) New England J. Med. 245 389-396 Sept. 13 1951

Doll and Hill support these conclusions. Despite all this evidence it is realized that there may be several causative factors, of which cigaret smoking is only one.

Lung cancer is mainly of two types, epidermoid (squamous) and adenocarcinoma. The epidermoid carcinoma and its undifferentiated variant are the ones which have shown the greatest increase in incidence. It is this type which is most prevalent in males and most commonly found in heavy smokers. Adenocarcinoma has not shown much change in incidence, is found about equally in both sexes and has a high relative incidence in nonsmokers. It seems probable that the "cigaret" cancer is the epidermoid variety and this is essentially different from adenocarcinoma in pathogenesis, the latter arising in response to different, still less clearly understood carcinogenic agents. Doubtless the time will come when tumors will be classified on the basis of causative agents rather than on histologic differences.

The potential malignancy of the bronchial adenoma is stressed. Graham believes that adenocarcinoma can develop from embryonic bronchial buds or adult bronchial epithelium. Histologically, there is a similarity between bronchial adenoma and the infantile types of structures, especially the bronchial mucous glands and the peribronchial and peritracheal lymphadenoid tissue found in human fetuses and newborn babies.

Only 25 or 30% of patients with lung cancer are suitable for resection. Confusion of the clinical picture of bronchogenic carcinoma with virus pneumonia in the older age group contributes to the small number reaching the surgeon early. In the author's clinic, of 109 patients on whom total pneumonectomy was performed before 1946, 19.2% survived five or more years. Use of preoperative respiratory function tests is advocated to determine the advisability of total pneumonectomy. For those who would be respiratory cripples after pneumonectomy, lobectomy is indicated, though the former provides better access to lymph nodes that may be involved.

Primary Carcinoma of Bronchus. Prognosis Following Surgical Resection. Clinicopathologic Study of 200 Patients. John Borrie[7] (Newcastle upon Tyne) discusses 200 pul-

(7) Ann. Roy. Coll. Surgeons England 16:165-186, March 1954.

monary resections among 1,800 patients with carcinoma. Study of lymph nodes of resected lungs showed that regional nodes of each lobe lie at the base of the segmental bronchi. In the right lung neoplastic invasion does not appear to progress from one lymph node barrier to the next, most frequently invaded groups are those lying between the upper and middle lobes and those medial to the right main bronchus. In the left lung the progress of spread is similar most frequently invaded are those groups of nodes between the upper and lower lobes and those medial to the left main bronchus

From study of lymph node invasion in relation to prognosis in the earlier resections, the following conclusions are drawn. (1) Having survived operation, after three years 82% of patients are dead, 70% from metastases. (2) There is a distinct difference in behavior between undifferentiated and epidermoid cell carcinoma, with 71% of the former and 30 5% of the latter fatal because of metastases one year after operation. Few patients with undifferentiated growths survive three years 26% with epidermoid growths live longer (3) Since 85% with lymph nodes invaded and 66% with no lymph nodes invaded die within three years of operation, the relation between lymph node invasion or its absence and long term survival is unclear except that lymph node invasion adversely affects prognosis and usually means death within three years of operation. (4) No significant prognostic factor exists between type of invasive growth and survival time (5) Number of nodes invaded/specimen was no guide to prognosis. (6) Lung carcinomas cannot be divided into three grades according to site of invading nodes as a basis for prognosis, for too many patients with no invaded nodes died early of blood borne metastases to allow such a claim (7) Invasion of mediastinal nodes usually meant death within 15 months of resection. (8) Upper lobe growths had slightly if not significantly more favorable prognosis

Deep x ray therapy has little effect on survival time but is useful in easing certain symptoms in cases not suitable for surgery (1) by causing necrosis in a tumor and thereby unblocking a blocked bronchus to allow reaeration of a collapsed lung (2) by relieving pain from metastatic deposits

in bone and (3) by relieving the suffocating distress of superior mediastinal obstruction.

Certain conclusions are derived from this study Surgery in treatment of primary lung carcinoma is still in its early years and final evaluation of results is yet to come Resection for lung cancer is possible in only 19% of cases "Cures" can be obtained, but extent of lymph node invasion in the operative specimen cannot be taken as a certain criterion of prognosis except that 20% of patients with resection are likely to be alive three years few with several lymph nodes invaded survive much over a year and, when one node or none is invaded and the growth is epidermoid, early deaths or late survivals may be found. The lymphatic system offers an important path for dissemination of growth and thorough mediastinal block dissection may be necessary (5) There may be early blood stream spread and pulmonary veins should be ligated before the pulmonary artery at resection in order to prevent further spread from operative handling Each patient should be approached individually and possibility of cure should be considered unpredictable

[In general the author's conclusions agree with ours at the Barnes Hospital. It is surprising, however that his study showed that the number of lymph nodes invaded by the cancer does not influence the prognosis.—Ed.]

Minute Peripheral Pulmonary Tumors Study of Eight Cases is reported by John T Prior and David B Jones (State Univ of New York, Syracuse) All neoplasms were identical in histologic appearance, were found accidentally at microscopic examination and were undoubtedly too minute to be seen with the naked eye Six tumors were observed at autopsy on persons dying of a variety of causes (bronchiectasis, heart failure pancreatitis and uterine carcinoma) and two were surgical specimens removed because of long-standing severe bronchiectasis. Seven patients were women

The tumor foci were readily apparent under low power magnification and were located peripherally and usually subpleurally Characteristically they consisted of sharply circumscribed epithelial nests enmeshed in a dense fibromuscular stroma These nests averaged 100 μ in diameter with 250 μ the upper limit A clear space separated them

(*) J Thoracic Surg 3 24 226 March, 1952.

from the surrounding stroma Most observers have regarded these spaces as lymphatic channels, a fact largely responsible for the impression that the neoplasms are malignant. The cells composing the nests were characterized by prominent vesicular nuclei, both spindle shaped and round. No nucleoli or mitoses were noted. The authors believe that these pseudolymphatic spaces are produced by shrinkage during fixation and embedding A second histologic pattern, observed in four cases, was an intrabronchiolar polypoid growth. The cells comprising these masses were subepithelial and cytologically identical to those within the fibromuscular stroma The bronchiolar epithelium was continuous over these masses but tended to undergo a transition to a flattened spindle-shaped type of cell. Serial sections failed to show that these intrabronchiolar lesions arose from the covering epithelium. Direct cellular continuity between these masses and the near by stromal tumor nests could not be demonstrated.

These tumors resemble most closely the pattern seen in carcinoid bronchial adenomas The concomitant occurrence of bronchiectasis in most recorded cases suggests that this condition may be a factor in pathogenesis.

Bronchogenic Small Cell Carcinoma. Robert P McBurney John R McDonald and O Theron Clagett[9] (Mayo Clinic and Found) report that among 849 cases of primary bronchogenic carcinoma of the lung seen during 1906-48 there were 90 small cell carcinomas They occurred predominantly in the fifth, sixth and seventh decades, and the ratio of men to women was 29 1. Race and occupation were not significant factors Average duration of symptoms from onset to diagnosis was 5.9 months five patients had symptoms for less than 1 month and only three for as long as 2 years. In general symptoms were identical with those of bronchogenic carcinoma cough, chest pain, dyspnea and episodes of pneumonitis Physical signs included dulness over the affected areas, diminished breath sounds, lag in respiration and râles.

X ray reports were available in 89 cases, and in all but 1 positive findings were listed In five cases bronchiectasis only was diagnosed but further evaluation revealed the

(9) J Thoracic Surg 22 63 73 J h 1951

bronchiectasis to be secondary to bronchial obstruction by a tumor There was a slight predominance of lesions on the right side Bronchoscopic biopsy was positive in 76.5% of cases, and in an additional 16% some evidence of disease was noted, but either a lesion was not found or biopsy of suspicious areas gave negative results Of 31 cases in which cytologic examination was done carcinoma cells were found in 29 In more than 70% in which there was subsequent tissue confirmation it was possible to diagnose the cancer as being of the small cell type With one exception, the tumors were located in the main bronchi or in a major secondary bronchus.

Diagnosis by cytologic examination is based on the finding of numerous cells with a high incidence of more than one of the following nuclear hyperchromatism, pleomorphism, coarse nucleoli or chromatin granules and a high nuclear-cytoplasmic ratio The tumor must be differentiated from atypical adenomas and true primary lymphosarcoma of the lung

Exploration was done on 29 patients, with pneumonectomy on 15 All the pneumonectomy patients were traced when last heard from two were still alive one 5¼ and the other 2¾ years after operation. All but six patients who did not undergo surgery were dead these six could not be traced but are presumed to have died X ray therapy was given to 17 patients and although several seemed to obtain good palliative results there were no survivors.

Small cell bronchogenic carcinoma is a definite entity and should not be included in the general group of anaplastic or undifferentiated cancer even though its behavior is of such a nature This conclusion is based on (1) the definite, easily recognizable microscopic picture (2) definite high incidence of positive results on cytologic examination and (3) characteristic clinical behavior Prognosis of these tumors is extremely poor

[I doubt that pathologists of the future will consider this group of cases to constitute a definite entity—Ed.]

Malignant Pulmonary Abscesses are discussed by Howard K. Gray James D Fryfogle and C Allen Good(1) (Mayo Clinic) These cavitating intrapulmonary neoplasms may

(1) S Clin. North America 31 1189-1206 August, 1951

produce the classic clinical picture of an inflammatory lesion and should always be considered in differential diagnosis, particularly in patients over 40 Exploration of a patient with a chronic cavitating lesion should be done with the intent to resect the lesion if it is operable Advent of the hilar dissection technic makes possible "clean" surgical extirpation. The older drainage technics leave an inflammatory residuum and may be followed by secondary changes such as fibrosis, bronchiectasis, bronchostenosis and atelectasis. Pulmonary resection is advocated when malignancy cannot be ruled out Of 22 patients with malignant necrotizing intrapulmonary lesions, 2 were not treated and 1 died on admission Drainage was performed as a palliative procedure in six Four patients were considered inoperable and received roentgen therapy *Of nine patients chosen for* resection, three lived an average of 27 months, one was alive and well 18 months postoperatively, three proved inoperable at exploration one died immediately after operation and one could not be traced

Since all but four patients had a productive cough, the authors believe that cytologic examination of the sputum may aid greatly in diagnosis of malignant pulmonary abscess and direct the surgeon toward resection in more cases.

Value of Exploration in Silent Lung Disease Richard H. Overholt[2] (Tufts College) believes that diseases of the lung can be more easily discovered during their early and silent form than those in any other internal organ Different pathologic processes within the lung may produce identical x ray shadows, whereas the same disease entity may produce different ones All shadows cannot be labeled accurately at a time favorable for successful treatment and an absolute *diagnosis may not be possible without opening the chest* cavity and removing tissue for examination. Surgical exploration and immediate excisional therapy if indicated are logical, direct and safe methods for differentiation and treatment. Of 200 cases in which intrathoracic explorations were done in a year it was impossible to establish an absolute diagnosis preoperatively in 37% *Of 54 cancers seen* during the year 61% could not be definitely diagnosed until after exploration.

(2) Dis. Chest 20 111 128 August 1951

Radiologic screening of the chest has brought an increasing number of potentially serious lesions under observation at an earlier stage of development In a survey in Boston, 23% of 333 suspected tumors seen in 536 012 chest films have been diagnosed as cancer

Treatment should not be delayed for results of guinea pig inoculations or cultures or to compare films for possible change Transthoracic aspiration to obtain tissue for diagnostic verification has no value

It is the surgeon's responsibility to do a safe exploration so that adequate tissue, representative of the lesion, is obtained and all possible healthy pulmonary tissue is conserved until diagnosis of cancer is proved If the lesion is benign local or limited excision should be done If it is malignant, operation with a wide excision of pulmonary tissue and mediastinal lymphatics is indicated The chest wall should be reconstructed to insure minimal discomfort and maximal restoration of function. Biopsy methods include surface biopsy wedge resection direct biopsy of a centrally placed tumor removal of enlarged lymph nodes and segmental resection.

Cure depends on the extent of the lesion and skill of the surgical team. When symptoms are present the likelihood of extrapulmonary extension is high (88 6%) and cure rates have been low When silent cancer is treated promptly the chance of extrapulmonary extension by lymphatic spread is low (75%) and cure rates should be high. The resectability rate is 30% when symptoms are present and 100% for silent cancer treated promptly

[Apparently the only way to improve our discouraging results in bronchogenic carcinoma is to get the cases earlier Overholt's recommendations are sound. More exploratory operations will mean fewer deaths from cancer.—Ed.]

Surgical Excision of Lung in Treatment of Lung Tumor Achille Mario Dogliotti and Antonio Bobbio[3] (Univ of Turin) review 126 cases of lung tumor seen from 1947 to 1950

Diagnosis is primarily radiologic Such clinical symptoms as cough, thoracic pain, dyspnea, hemoptysis asthenia and fever are not unique to the lesion and are not diagnostic proof of lung tumor however if they persist despite medi

(3) Minerva med. 42:903-917 May 4 1951

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(3) Minerva med. 42:905-917 May 26, 1951

cation in a patient aged 40-60, they should arouse suspicion and demand periodic x ray examination as long as the symptoms last Normal lung transparency makes x ray investigation the ideal method to discover even slight abnormalities which appear with many details of form, site and extent. Contrast mediums are not necessary This information, without bronchography, will often suffice for diagnosis and evaluation of operability Bronchographic information by bronchoscopy is sometimes more precise and should never be neglected In doubtful cases bronchography may furnish important information regarding function and disclose early signs of neoplastic invasion. It has also been useful in differentiating extrapulmonary masses from genuine lung tumors.

Clinical classification of lung tumors and evaluation of operability are usually based on x ray studies Tumors are classified as hilar, when they originate in the principal bronchus or the lobar bronchi, parahilar, when in segmental bronchi, or peripheral when in medium and small bronchi. Hilar tumors spread rapidly by the lymphatic route to the hilar lymph nodes and thence to mediastinal nodes, forming a matrix around the hilar and the mediastinal elements, making them inoperable They cause coughing dyspnea and sometimes slight hemorrhages. They occlude air passages and cause atelectasis, resulting in fever and infection. Rapidly progressive, they are inoperable within six months after the appearance of symptoms. Parahilar tumors spread more slowly causing symptoms similar though less severe and extensive Peripheral tumors rapidly destroy the bronchi where they originate and spread concentrically in the lung parenchyma, compressing it as they expand, forming so-called ball tumors They often remain silent for a long time and sometimes are discovered accidentally in routine x ray examination Their lymphatic spread is slow and they respond with best long term results to lobectomy and pneumonectomy Should they invade the visceral or parietal pleura, especially if the costal wall and the supraclavicular fossa are involved operation is absolutely contraindicated

Evaluation of operability should include study of the respiratory system and the patient's general resistance. Advanced age is a serious contraindication, except in favor

able conditions, seldom found in patients with malignant tumors. Extension of the tumor beyond the lung and into adjacent structures also indicates inoperability. Condition of the liver and kidneys and possible concomitant debilitating lesions should be considered. Lesions that involve the heart and circulation may cause failure because of increased cardiac strain during postoperative functional readjustment. Extreme weakness and dyspnea on slight exertion obviously foreshadow the patient's inability to withstand thoracic surgery.

Lobectomy is indicated when diagnosis is doubtful, even on anatomic examination, when the tumor is peripheral to the hilus with no evident lymphatic dissemination outside the lobe, when there are small, possibly benign, tumors in the segmental bronchi (bronchial adenomas) and when circulatory and respiratory inadequacy contraindicate pneumonectomy.

Pneumonectomy is the choice in all other instances of lung tumor. Variations in technic are usually limited to approach, ligation of vessels of the stump and suturing of the bronchus. The anterior approach, although less convenient for the surgeon, is undoubtedly best for the patient, who can lie naturally on his back without asymmetrical compression of the thorax, which makes breathing difficult and increases the work of the heart. If difficulty in freeing the lower lobe or need of intrapericardial ligation of the pulmonary veins is anticipated, lateral approach is the alternative.

Various methods of closing the bronchus have been proposed. The authors, after obliterating the lumen with two U shaped silk sutures and approximating the edges of the sectioned bronchus with separated sutures of catgut, carefully cover the stump with the mediastinal pleura and any available connective tissue. Solid cicatrization, which takes place almost exclusively in the surrounding connective tissue assures obliteration of the bronchus. Sedation of cough, careful aspiration to free the bronchial tree from obstruction and drainage of the cavity should never be neglected. Separation of the bronchial stump causing formation of a fistula is a serious complication and sometimes results in death. Use of penicillin before and after operation and other

precautionary measures will reduce infection to a minimum.

Of 12 patients who had lobectomy, 1 died at operation, 2 could not be followed up, 2 died within a year of operation, of the other 7, 3 were alive after 27 months (1 after 3 years), 2 after 12-24 months and 2 after less than 12 months. Of 39 patients who had pneumonectomy, 5 died postoperatively and 10 at varying times thereafter, 10 had not been heard from and 14 were alive. Of the living 2 were in excellent condition after more than 24 months and one was in good general condition but had a metastatic lesion which was responding to roentgen treatment.

Conservation of Tissue and Function in Pulmonary Resection. Technic of Anatomic Separation of Segments is described by Beatty H. Ramsay[4] (Los Angeles). Segmental resection is valuable not alone for biopsy of a localized mass or removal of a localized benign process but perhaps chiefly for treatment of bronchiectasis which usually affects some segments of several lobes and which requires surgical removal for cure. If only diseased segments of lobes are removed it is often possible to preserve sufficient normal lung tissue to protect against pulmonary insufficiency (Figs. 40 and 41). Another promising field for this procedure is in tuberculosis.

The fundamental unit of gross pulmonary structure is a conical structure of pulmonary parenchyma which has a central bronchus and artery and a network of veins arranged peripherally and converging at the apex where the bronchus and artery enter. Whether or not the fundamental unit has a central vein is not known. Two or more units are always combined to form larger units. When they do so the peripheral veins at the points of contact mark the borderline between individual units; therefore they can be called interunitary veins. Theoretically, then, any unit can be separated from its neighbor by locating the interunitary vein and following it and its branches in the plane of separation.

Two fundamental units thus combined form a structure with (1) peripheral veins on the noncontact surfaces converging on the common hilus, (2) one or more veins at the plane of contact (interunitary veins), (3) a junction of the

(4) California Med. 76:333-336, May 1952.

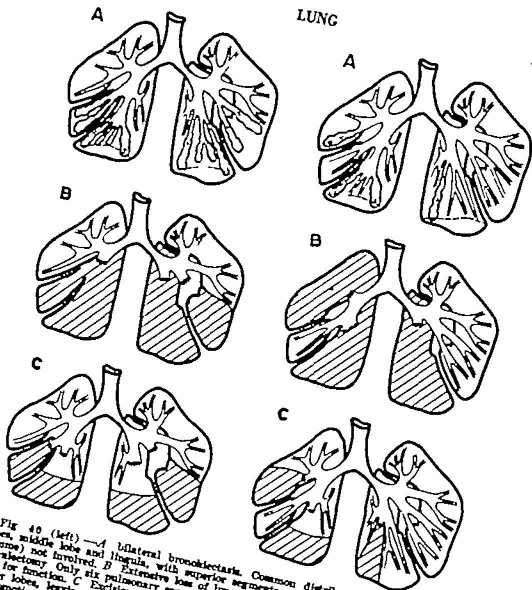


Fig 40 (left) —*A* bilateral bronchiectasis. Common distribution in both lower lobes, middle lobe and lingula, with superior segments of lower lobes (about 3/7 by volume) not involved. *B* Extensive loss of lung tissue with excision by lobectomy and lingulectomy Only six pulmonary segments (equivalent of two right upper lobes) are left for function. *C* Excision of diseased segments only preserves superior segments of lower lobes, leaving equivalent of two right upper lobes, a middle lobe and lingula for function.

Fig 41 (right) —*A* scattered bronchiectasis involving four segments in three lobes. *B* Excision by lobectomy (three entire lobes) leaves only a complete left upper and middle lobe for function. *C* Excision by segmental resection preserves almost all normal lung. Note that all right lower lobe basal segments are removed, because here the two normal segments, if left, might be displaced with resulting obstruction and disease; it is quite feasible however to preserve all normal segments. (Courtesy of Ramsay B H. California Med. 76 332-336 May 1952.)

peripheral and interunitary veins at the hilus to form a common trunk (4) a bronchus of supply for each unit at the hilus combining to form a single bronchus, and (5) an artery of supply for each unit combining to form a single artery Thus the combination unit has a central artery and

bronchus and peripheral and interunitary veins When more than two units unite, the same principle is found Two or more groups of units combine to form segments or lobes.

The largest components of any lobe, the bronchovascular segments, have been named The bronchus of supply is of the third order (*after the main stem and lobar bronchi*) Like any smaller group of lung units, it has centrally a (segmental) bronchus, (segmental) artery, often a (segmental) vein and peripheral veins converging on the hilus Peripheral veins which mark the plane of separation from a contiguous segment are known as intersegmental veins the others are subpleural veins.

The diseased segment is usually apparent on inspection or palpation occasionally bronchography alone is of assistance Since the segmental bronchus contains cartilage it can be palpated with ease and followed by touch into the segment until there is no doubt that it supplies the diseased segment This having been done, the bronchus is dissected clamped distally, sectioned near its origin and the *proximal stump closed. The segmental artery accompanying* the bronchus is exposed during the bronchus dissection and is divided when encountered Any subpleural veins and/or segmental veins which are present are divided as they become evident. The segment is then detached from the adjacent lung parenchyma, using the intersegmental vein as a guide to the plane of separation. In most instances the *intersegmental vein arises equally from adjacent segments* and should be preserved by dissecting between the vein and the diseased segment.

Segmental Resection for Pulmonary Diseases William S Conklin and Harry Westerberg[5] (Portland Ore) point out that resection for pulmonary disease does not necessarily mean complete removal of one or more lobes of the lung *Segmental resection, the most recent technical advance in* pulmonary resection, can be used in many cases in an effort to preserve as much normal lung tissue as possible The lungs are comprised of 18 bronchovascular units, 10 on the right and 8 on the left. These segments, where not bordering on fissures, are separated by planes *that generally contain* no important structures other than intersegmental

(5) J A. M. A. 146 633-641 June 16 1951

veins. Dissection along these planes can be accomplished readily and the segments can be removed, singly or in groups, after division of the segmental bronchus, artery and vein at their origin. When performing segmental resections it is important to preserve the intersegmental veins with the nonresected adjoining segments

Segmental resection is applicable in some types of bronchopulmonary disease in which removal of the involved portions offers the only means for cure or maximal palliation. It is recommended when involvement is so extensive that lobar resections would cause excessive reduction in respiratory function. Nonresected portions have space filling as well as functional value

Segmental resection is indicated mostly in bronchiectasis and tuberculosis It is also indicated in other types of chronic suppurative disease such as lung abscess infected lung cyst, empyema with bronchopleural fistula and extrapulmonary cyst with bronchocystic fistula and secondary suppuration. It may be used in mycotic lung disease, spontaneous pneumothorax localized emphysema or cystic disease with or without a fistula pulmonary arteriovenous aneurysm, broncholithiasis, and foreign body in a bronchus or lung trauma. In bronchopulmonary neoplasms, whether benign or malignant, the operation is rarely advisable

The following technical points deserve consideration. The segmental artery bronchus and vein should first be isolated at the hilus, and intersegmental veins should be identified and preserved Application of clamps across lung tissue should be avoided. An attempt to cover the raw lung surfaces left after resection by bringing the edges of the visceral pleura together is unnecessary and generally inadvisable since it diminishes lung volume and function by constricting a portion of the lung

Segmental resection was performed 50 times on 48 patients. Indications were tuberculosis, 25 bronchiectasis, 17 chronic lung abscess 2 and teratodermoid cyst with bronchocystic communication and secondary suppuration, bronchopulmonary suppuration secondary to a foreign body in a bronchus, ruptured emphysematous bleb with persistent fistula, and pulmonary arteriovenous aneurysm, 1 each. Of 21 patients (23 operations) with chronic suppurative disease

3 had bronchopleural fistula with empyema, 1 transient pulmonary insufficiency, 1 lung abscess and 1 atelectasis. In two, empyema responded promptly to open drainage, with obliteration of the empyema space and closure of the fistula. All patients with bronchiectasis are considered improved since surgery. Bronchopleural fistula and empyema occurred in two of 25 operated on for tuberculosis. One died later of progressive tuberculosis. Contralateral spread occurred in one. There was only one operative death, due to pulmonary atelectasis. All but three patients have negative sputums. No complications occurred in the miscellaneous group.

Pneumonectomy for Severe Irradiation Damage of the Lung is reported in two patients by Martin Bergmann and Evarts A. Graham[7] (Washington Univ.). X-ray irradiation of the chest can produce severe lung damage, even when limited to the therapeutic range for breast carcinoma or intrathoracic neoplasms. Characteristically the clinical history is that of a middle-aged (or elderly) woman with recent mastectomy followed by postoperative x-ray treatments. During therapy or three to six weeks later, a dry or moderately productive cough begins. If irradiation is less than 140% of the skin unit dose, the cough may persist for several months and eventually disappear. With more irradiation reaching the lung, the cough may become progressively worse, with variable amounts of sputum. Paroxysmal and disabling dyspnea and chest pain are common. Occasionally there is hemoptysis. Fever may result from superimposed secondary infection, but ordinarily the patient is in good health as compared to persons with tuberculosis or metastases. The affected hemithorax usually shows scaling, pigmented and/or indurated skin changes and diminished respiratory excursions. Impaired percussion note with rales and bronchial breathing may be found and later breath sounds, voice sounds and fremitus may be diminished or absent.

Diffuse haziness is usually the first x-ray sign. Later irregular consolidations appear, radiating from the hilus, and possibly also pleural reactions and adhesions (and occasionally effusions). Later changes are pulmonary sclerosis and shrinkage with atelectatic lung, with trachea and

(7) J. Thoracic Surg. 22:549-567, December 1951.

mediastinum shifted to the affected side and the interspaces narrowed Bronchiectatic cavities may be visible The lateral view may show more severe anterior changes. Findings must not be confused with metastasis so that further irradiation (with increased damage) is not given

Unilateral radiation damage results in severely marked restricted vital capacity Hyperventilation and reduced maximal breathing capacity diminish breathing reserve to as low as 40% Reduced maximal breathing capacity is caused by immobile hemithorax, scar replacement of lung parenchyma and inflammatory changes, but hyperventilation is apparently caused by abnormal reflexes from the altered lung Abnormal reflexes and structural changes (accounting for cough, sputum, chest pain and occasional hemoptyses) point to pneumonectomy as the logical treatment of unilateral radiation damage Even when the ultimate prognosis is doubtful, palliation of distressing symptoms through pneumonectomy should be proffered if survival for a reasonable time is likely

In the two patients reported on, irradiation dosage was unknown but symptoms were severe Pneumonectomy gave pronounced relief, even though results in one were unfortunately marred by empyema 22 months postoperatively although no evidence of relationship to irradiation was found.

Removed specimens showed typical marked increase of elastic tissue throughout the affected lung Such changes otherwise occur only in healed pulmonary infarcts and apical scars. One patient had alveolar epithelial hyperplasia, whereas the other showed more advanced, fibrotic lung condition. Absence of hyaline membranes, previously observed at autopsies, indicates that this feature might be an agonal artefact Cartilage smooth muscle and connective tissue showed no clear changes.

[Less degrees of this clinical picture are probably not uncommon and pass unrecognized. It is important to realize that the lung is very susceptible to irradiation damage.—Ed.]

Plastic Restoration of Trachea and Bronchi. According to H. Métras, H. Longefait, M. Gregoire and L. Hartung[6] (Marseilles) peribronchial tissue is important in the cica

(6) Presse méd. 60:427-429 Mar 26 1952.

trization of the divided bronchus and in the success of plastic repair, either by bronchial pedicle flaps or by grafts. Repair may be done with displaced tracheobronchial tissue or with prosthetic material. It is much more difficult when

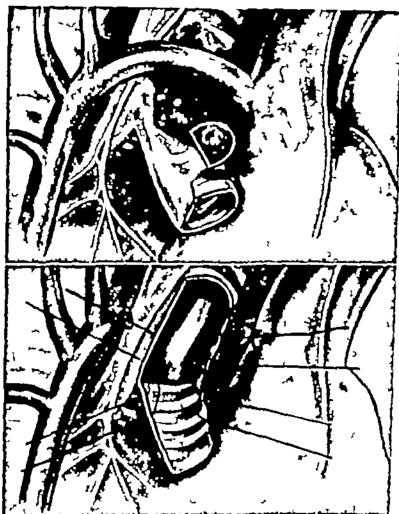


Fig 42 (top) —Bronchus cut in healthy rea in case of bronchial and tracheal in olvement.
Fig 43 (bottom) —Reflection pward of healthy bronchial pedicle t cover defect caused by loss of tissue.
(Courtesy of Métras, H et al Presse méd 60 427-429 Ma 26 1952)

loss of substance involves the whole circumference, especial ly along more than 4 cm. than when it involves only a side In the latter case e g in excision of a bronchial lesion that has invaded the lateral aspect of the trachea, the bronchus may be cut in a healthy area and part of it

brought up to cover the loss of tracheal tissue (Figs. 42 and 43) This allows repair of the defect in the trachea without decreasing its diameter

Autografts are preferable to homografts as they are better tolerated and less likely to slough or suppurate Dermis and fascia lata are most often used, but they are unfortunately not rigid enough and flatten out during respiration, rigid, spiral metallic wire is therefore used for support Use of homografts and of inert material (Vitallium or polyethylene) is still in the experimental stage

Benign and malignant tumors and scarring stenosis are the most frequent indications for restoration In tuberculous stenosis timing is essential, and the tuberculous process must have become inactive

Sequelae of Treatment of Hydatid Cysts of Lung are discussed by S C Fitzpatrick[8] (Hamilton) In 80 cases, operative mortality was 5% The unruptured pulmonary hydatid cyst if removed completely and with adequate safeguards, has few sequelae and a mortality rate of less than 1% Of the 70 patients followed, only 20 had complications and they were usually due to preoperative rupture Four types were observed

1. Three patients died of anaphylactic shock However, only one was operated on.

Woman, 65 had a cyst in the right lower lobe and one in each of the upper lobes (Fig 44) The cyst in the right lower lobe ruptured spontaneously and was evacuated on Sept. 19, 1942. While she was awaiting further operation, the cyst in the right upper lobe ruptured and produced severe anaphylactic shock. It was evacuated on Dec. 18 1942. To prevent the third cyst from rupturing, on Jan. 2, 1943, under endotracheal anesthesia the cyst in the left upper lobe was exposed. Before it could be opened, a fluid rattle was heard in the chest, the face became pale and the heart stopped beating Death was considered due to slight leakage of hydatid fluid which caused acute anaphylactic shock.

Probably the only way this patient could have survived would have been by operative removal of both cysts of the right lung followed by removal of the third cyst within 14 days.

2 Lung hydatid abscess, persistent sac and chronic empyema, often communicating with a bronchus and/or the pleural cavity usually follows incomplete removal of the

(8) Australian & New Zealand J Surg 20 78-244 May 1951.

cyst wall. The thin adventitia lining a hydatid abscess eventually thickens (becomes 1/4 1/2 in. thick) and irreversible changes ("obstructive pneumonitis") take place in the surrounding lobe which require lobectomy These changes explain why there is a time limit to the possibility of cure with complete recovery of lung function. In one patient spontaneous rupture of a hydatid cyst into a bronchus resulted in the coughing up of five cysts and complete



Fig. 44 —Multiple bilateral cysts. (Courtesy of Fitzpatrick, S. C. Australian & New Zealand J Surg. 20 278 284 May 1951)

ridding of the lung of disease Often, however tension pneumothorax or acute pyopneumothorax result from spontaneous intrapleural rupture or operative removal without proper safeguards Adequate safeguards against these sequelae include avoidance of soiling of the pleura by use of combined suction bell and trocar cannula, negative pressure drainage of the residual and pleural cavities until the bronchial communication which in large cysts results at operation, is proved by x ray study to have closed and the cavity disappeared and frequent x ray studies and bronchography if closure is prolonged.

3 Recurrence of daughter cysts, due to incomplete removal of cyst fluid containing brood capsules and scolices, is commoner when removal of an unruptured cyst has been followed by aseptic healing since infection kills the brood capsules and scolices Refinements in technic should obviate this sequel When it is suspected that hydatid elements are still present, and when there is no bronchial communication, the interior wall of the emptied cavity should be rubbed with a swab moistened with 7% Formalin solution.

4 Bronchiectasis is due to pericystic inflammation, manifested clinically by purulent sputum and hemoptysis and on x ray by pulmonary sclerosis and cavity formation. Further evaluation of the relation of bronchiectasis to hydatid cysts is needed but it is true that both are more commonly found in the lower lobes of the lungs Probably few simple cysts operated on with adequate safeguards give rise to bronchiectasis

Advances in anesthesia blood transfusion, fluid and electrolyte balance, chemotherapy antibiotics, lobectomy and pneumonectomy have greatly reduced postoperative mortality Thus series extended over 28 years, the only death in the last 15 was due to acute anaphylactic shock Lobectomy is the preferred treatment for old lung hydatid abscesses and persistent thick walled cavities

Pulmonary Resections for Metastatic Lesions J L Ehrenhaft[9] (State Univ of Iowa) states that to prevent pain and lengthen life it is sometimes of value to remove pulmonary lesions which have metastasized from malignant neoplasms primary elsewhere in the body Solitary metastatic pulmonary lesions may be present at the time the primary lesion is diagnosed or may appear months or years after complete removal of the primary extrapulmonary tumor Indications for selection of nine patients were (1) apparently complete removal of the primary neoplasm without evidence of local recurrence, (2) absence of demonstrable metastases to other organs of the body and (3) reasonable assurance that all metastases were located in one area, making surgical resection of that area possible

Case I—Woman, 50 with adenocarcinoma of the cervix, treated with x rays and radium in 1037 had hypertrophic pulmonary osteo-

(9) A.M.A. Arch. Surg. 63 326-336 September 1951.

arthropathy and evidence of pulmonary metastasis in 1946 She died six hours after pneumonectomy

CASE 2.—Girl, 13, with anaplastic epidermoid carcinoma of the nasopharynx was treated by x rays in 1946 In 1948 after evidence of lung metastasis, partial pneumonectomy was done. In 1950, two weeks after delivery of her second child, widespread metastatic carcinoma secondary to epidermoid carcinoma of the pharynx was diagnosed. She died one week later

CASE 3—Man, 63, had radical removal of malignant nasal melanoma in 1948 In 1950 segmental resection was done for solitary metastasis to the lung He was apparently well one year later

CASE 4.—Man, 60, had transurethral resection of a transitional cell carcinoma of the bladder in 1945 In 1950 he had pneumonectomy and regional lymph node resection for metastasis, but metastasis to the other lung was noted five months later

CASE 5—Man, 70 had partial resection of the stomach for adenocarcinoma in 1944. In 1950, recovery followed lobectomy for metastatic chest lesion. Eight months later there had been no recurrence.

CASE 6—Woman, 56 had resection of the sigmoid for carcinoma in 1945 In 1950 a metastatic lesion developed in the lung and pneumonectomy was done. She was apparently well nine months later

CASE 7—Woman 34, had hysterectomy in 1946 for leiomyomas of the uterus with sarcomatous changes. In 1950, pulmonary osteoarthropathy developed, and a solitary metastatic lesion in the left lung was resected Seven weeks later a solitary lesion was resected from the other lung She was asymptomatic 4½ years after hysterectomy

CASE 8—Woman, 33 had radical mastectomy in 1948 In 1950 right pneumonectomy for a solitary metastatic lesion was followed in about two months by a superior vena cava syndrome probably *due to metastasis to the mediastinum. Nitrogen mustard relieved* symptoms, and she was active five months after pulmonary resection.

CASE 9—Man, 37, had orchidectomy in 1950 for teratocarcinoma, followed in nine months by wedge resection of the lung for metastasis. He was symptom free three months later

[Local removal of an apparently solitary metastasis to a lung certainly seems indicated. However it is doubtful if a radical resection, such as pneumonectomy should be performed, because at the present time enough experience has not accumulated to indicate whether the advantage of a wide resection *outweighs the danger of making the patient a respiratory* cripple.—Ed.]

Pulmonary Resection for Tuberculosis Report of 40 Consecutive Cases seen between 1936 and 1950 is presented by Gustaf E. Lindskog and F Dana Law [1] The purpose of the operation is to remove the principal diseased areas in the lung so that a more favorable immunobiologic relationship can be established with the remaining infection. Pneumonec-

(1) Yale J Biol. & Med. 23 474-481 June 1951

tomy was done in 26 cases, lobectomy in 10 and bilobectomy in 4 Early in this study mass ligation at the hilus was done and no streptomycin was used, more recently, structures were individually ligated and the patients were given streptomycin at least postoperatively Mortality rate was 10%

Positive sputum was found in 72.5% of the cases before resection, and contralateral disease was present in 65% Operative risk was estimated preoperatively as good in 14, fair in 20 and poor in 6 The main indications for resection were thoracoplasty failure (13 cases), tuberculous bronchiectasis with or without bronchostenosis (12) and uncontrolled cavity with or without tension (8) Complications occurred in 30 per cent of the cases, particularly those in which sputum was positive and operation was done for an uncontrolled cavity They usually consisted of bronchopleural fistula, empyema pulmonary spread and/or wound infections. Fistula, empyema, spread, mediastinitis, wound infection and eventual death in the nineteenth postoperative month occurred in one case with an erroneous diagnosis This series of events illustrates the consequences of such an error and use of the now outmoded mass ligation technic

Most patients have been followed three years or longer Five are dead, four of tuberculous complications and one of rheumatic heart disease When last heard from, 31 of the 35 survivors had negative sputum and the disease appeared arrested on x ray They were carrying on light or moderate activity Four patients were still in sanatoriums Two of these four had Schede thoracoplasty wounds, incident to treatment of empyema which were slowly closing a third had recently finished a course of chemotherapy for a laryngeal lesion, and a fourth was convalescing from a recent operation Use of the individual hilar ligation technic the increasing benefits from antibiotics and, more recently segmental resection are widening the scope of pulmonary resection. On the basis of this survey the authors indications for pulmonary resection in the future will include thoracoplasty failure, bronchiectasis with or without bronchostenosis, chronic empyema with destroyed lung tuberculoma and suspected tumor Because of the unfortunate results of resection in eight patients with uncontrolled cavities active parenchymal infiltration and highly positive

sputum (complications in 87 5% and a 37.5% mortality), resection is now regarded as contraindicated for such patients.

Simple Excision in Treatment of Pulmonary Tuberculosis The common finding of single fibrocalcific nodules in the lower and anterior portions of the pulmonary lobes at autopsy on persons who die of causes other than tuberculosis proves that tuberculous foci in these regions commonly heal. However, bacilli containing particles that lodge in the superior and posterior portions of pulmonary lobes commonly induce progressive pulmonary disease. The cardinal difference is that the necrotic focus in the lesion in the upper portions of lobes commonly sloughs into its connecting bronchus, whereas sloughing of lesions seldom occurs in other areas

Often there are considerable areas of tuberculous pneumonia which do not proceed to necrosis These heal by complete resolution or scar formation. Other areas undergo necrosis and are irreversible All necrotic areas tend to slough. The larger the lesion the greater is the hazard, because organization by fibrosis is slow and difficult A discharge of the softened necrotic debris into bronchi leads to formation of the tuberculous cavity, and, since the necrotic area is seldom cleanly sloughed, the cavity "wall" is composed of some necrotic lung tissue This makes complete healing of cavity by scar formation difficult and leaves on closure" of cavity an area of necrotic material surrounded by scar tissue with the bronchus plugged only by inspissated debris at best Such a filled in cavity can again become open if the contents become sufficiently fluid to flow down the bronchus. Persistence of the unhealed necrotic lesions in persons who have become clinically well is the cause of relapses.

With combined streptomycin and para-aminosalicylic acid therapy progressive clearing of roentgen shadows takes place to a point beyond which stable shadows remain. Tuberculous cavity formations usually are lost to view with shadows of demonstrable size remaining These changes represent disappearance of reversible pneumonic areas persistence of necrotic pneumonic lesions and filling in of cavities.
Bernard J Ryan, Edgar M. Medlar and Edward S Welles[2]

(2) J Thoracic Surg 23 327-340 April, 1952

(V.A. Hosp., Sunmount N Y) felt that by doing small resections on early localized lesions the dangerous portion of the infection might be eliminated and spreads and prolonged periods of invalidism caused by relapses prevented Residual necrotic foci were found in each patient operated on for a minimal lesion, and tubercle bacilli were present in each lesion despite repeated negative gastric and sputum cultures. Operation is not done until the sputum is negative and a stationary roentgen picture is established Usually only wedges of lung are resected (subsegmental resection) although on occasion removal of an entire lobe or a lung may be necessary Some patients have many small nodules scattered throughout a lobe or a lung and in such instance one hesitates to sacrifice so much healthy lung parenchyma Nodules in the superior portions of lobes are resected, usually by wedge resection, because they are in the vulnerable portions of lobes Wedges may be removed from other parts of the lung if numerous nodules are present in the area. In any location, lesions over 0 5 cm are removed singly Minute lesions in the lower portions of lobes are left undisturbed as there is a strong tendency for small necrotic lesions in such locations to heal

In 30 patients operated on, there was little change in the cardiorespiratory reserves No postoperative complications arose in four with minimal disease and in the others they were limited to hemothorax and atelectasis in one patient each As a rule the postoperative course was benign and all patients eventually were in excellent condition.

Pneumonectomy with Immediate Thoracoplasty in Treatment of Pulmonary Tuberculosis is advocated by Gordon Cruickshank and El Papamichael (3) The purpose of performing thoracoplasty at the same operation is to prevent excessive mediastinal shift and obliterate the pleural space as rapidly as possible thus reducing the possibility of a bronchopleural fistula or empyema Thoracoplasty as usually performed three to six weeks after pneumonectomy does little to prevent development of these complications.

TECHNIC.—The patient is placed in the head down position, a thoracoplasty incision is made and the 6th rib is resected subperiosteally It may be necessary to remove two ribs. After pneumonec

(3) Thorax 6.359 374 December 1951.

tomy has been completed, the patient's condition is carefully assessed. If all is well, thoracoplasty is carried out. As many ribs are removed as are necessary to obliterate the hemithorax space completely Usually removal of the 2d to the 7th ribs is enough. Normally the 2d to the 6th ribs are resected from the transverse process, which is left intact, to the anterior axillary line. Only the back end of the 7th rib is removed to allow the scapula to fall in. A drainage tube is placed through the 9th intercostal space posteriorly and is connected with a suction pump The tube is removed in 48 hours.

One stage pleuropneumonectomy and thoracoplasty was performed on 15 patients There was no mortality or morbidity All patients tolerated the procedure well, none had empyema or bronchopleural fistula, and all had negative sputum cultures after operation The wounds healed by first intention All patients could cough well postoperatively, and paradoxical respiration has been minimal. Deformity was not great.

Thoracoplasty Combined with Resection for Pulmonary Tuberculosis William S Conklin, John E. Tuhy and Jerome T Grismer[4] (*Portland, Ore*) discuss 38 tuberculous patients in whom pulmonary resection and thoracoplasty were performed at the same time Most had far advanced bilateral disease In six, pneumonectomy was done, in 29, upper lobectomy, and in 12, segmental resection alone or in conjunction with lobectomy There was one postoperative death. The combined operation seemed to be well tolerated and the incidence of postoperative complications was low Bronchopleural fistula occurred twice Only one patient now has positive sputum and this is attributed to pre-existing contralateral disease The remaining 36 patients (95%) are considered candidates for permanent arrest of the disease

The combined operation has the following advantages over resection and thoracoplasty performed separately The thoracoplasty need not be as extensive or radical as when it is performed before or after subtotal pulmonary resection. Hence, it is followed by less deformity less disturbance of function of the shoulder girdle and probably less disturbance of respiratory function. The extent of thoracoplasty can be conformed to the size of the pleural dead space The procedure can be performed through a shorter incision thus there is less damage to shoulder girdle muscles. The

(4) J Thoracic Surg 22 271 294 September 1951

hazards of bronchopleural fistula and empyema are thought to be less, owing to more rapid obliteration of the pleural dead space The expense and risk to the patient are less

TECHNIC.—The pleural cavity is entered through the periosteal bed of the fourth rib after a short posterior segment of the rib has been removed. The incision is extended along the fourth intercostal space After significantly involved lung segments have been resected, adhesions to the remainder of the lung are separated and decortication is performed if indicated. If the patient's condition is satisfactory, the thoracoplasty is completed with resection of the posterior portions of the third and fourth ribs and the first two ribs forward to, or almost to, the cartilages The trapezius and rhomboid muscles are divided either to a limited extent or not at all. The posterior rib stumps are purposely left long, and the transverse processes and erector spinae muscles are not disturbed. Ordinarily four or five rib thoracoplasty is performed. Second stage lower phase thoracoplasty may be carried out later if necessary

[Why enter the pleural space through the bed of the 4th rib? Because of the presence of the scapula it is much easier if the incision is made through the bed of the 5th or even the 6th rib.—Ed.]

Indications and Contraindications for Decortication Procedures in Pulmonary Tuberculosis are discussed by O. A. Abbott C P Bailey E B Kay D L. Paulson, R R. Shaw and D H. Waterman 5 The operation, a valuable one which can result in restoration of pulmonary function, should consist in removal of both parietal and visceral peels, mobilization of the diaphragm correction of infolding of the lung and avoidance of damage to the phrenic nerve and other subpleural structures Sputum tests should be negative for a minimum of one year before surgery in the average case of simple decortication, though a longer period is usually preferable Of major importance in preoperative evaluation is examination of the precollapse chest x ray The extent and type of underlying parenchymal disease before collapse are more important than duration of collapse

Decortication should be considered for the unexpanded lung after therapeutic pneumothorax and after spontaneous pneumothorax with or without persistent fistula, for fibrothorax with or without pneumothorax and for empyema, either tuberculous or mixed. It should also be considered when fibrothorax prevents satisfactory thoracoplasty over an upper lobe when constricting peel over a healthy lobe is associated with a diseased lobe which requires resection

(5) Dis. Chest 1 584 598 May 1952.

or permanent collapse and when there is bilateral disease presenting unilateral unexpandable lung or fibrothorax which precludes desired collapse or operative therapy on the contralateral side Areas of serious major tuberculous disease should not be treated by decortication but by con comitant resection or subsequent thoracoplasty Cavity bearing areas should not be allowed to re-expand fully Presence of pleural fluid is not considered important un less there is true empyema, then the operation is danger ous, particularly in mixed infections if the offending tu berculous organisms are streptomycin resistant The thick ness and character of the peel does not necessarily influ ence the operative result to be expected. Adequate drain age, a clear airway, chemotherapy and early rehabilitation chest exercises are important postoperative factors influ encing a successful result

Simultaneous Decortication and Resection in Unsuccessful Pneumothorax. Arnold O Riley and Victor H. Kaunitz[6] state that the problem of unexpandable lung after pneumothorax and its complication, tuberculous empyema, is a serious one Incidence of unexpandable pneumothorax has been mentioned as 5-10% In about 50-70% of all pneumothoraxes, fluid develops the irritating effect of which re sults in development of a fibrous membrane on the visceral and parietal pleuras this sometimes prevents re-expansion of the lung, when pneumothorax treatment is discontinued. About 15-20% of pleural effusions in tuberculous patients will finally develop into empyema after pneumonolysis, empyema will develop in about 6% This tuberculous empyema membrane likewise prevents re-expansion of the lung A further serious complication of empyema is the development of a bronchopleural fistula

After discontinuance of the pneumothorax there is a shift of the mediastinum, elevation of the diaphragm, flat tening of the chest wall and no re expansion of the lung This leads to overdistention of the contralateral lung with associated danger of reactivation, dysphagia due to retraction of the esophagus, deformities of the thorax and limi tation of respiratory function

Total thoracoplasty and Schede thoracoplasty have been

(6) J Thoracic Surg 22 341-357 October 1951.

unsuccessful when used to obliterate the tuberculous empyema and have no effect on active disease that has been unarrested by the pneumothorax

Decortication is the best method of handling these unexpanded lungs Of primary importance is the status of the underlying lung A positive sputum established as arising from the encased lung is a warning that simple decortication will not be definitive and further may be disastrous by way of spread The uncontrolled parenchymal focus assumes major significance, and its treatment must be a part of the total therapeutic plan Extent of parenchymal involvement before induction of therapeutic pneumothorax should always be defined before decortication. Widespread parenchymal involvement may produce sufficient fibrosis to prevent maximal re-expansion postoperatively, resulting in failure to fill the pleural space

Decortication is indicated in those with a successful pneumothorax with negative sputum who have a peel, with or without fluid surrounding the lung or who have had tuberculous empyema It is also indicated in those with unsuccessful pneumothorax, with positive sputum, with a peel or tuberculous empyema with or without bronchopleural fistula Decortication can be used in spontaneous tuberculous pleurisy with effusion resulting in unexpanded lung and empyema

Simultaneous decortication and resection is useful in successful pneumothorax when complete re-expansion is undesirable or impossible because of extensive parenchymal disease, with its danger of reactivation, or when there is widespread fibrosis of peel to parenchyma that makes decortication technically difficult or impossible In this situation preliminary tailored thoracoplasty is done and usually consists of subperiosteal resection of the first two and shorter portions of the third and fourth ribs. As soon as the chest wall is stabilized (in three to four weeks) decortication of the healthy portion of the lung is done leaving the diseased areas untouched

In cases of unsuccessful pneumothorax with uncontrolled parenchymal disease and unexpandable lung permanent collapse by thoracoplasty is not indicated. In these cases preliminary tailored thoracoplasty is first performed if more

than a block or segmental *resection is contemplated After* a short interval, resection of the involved parenchyma is done and the healthy portions of the lung are decorticated If pneumonectomy is necessary, due to bronchial disease or destroyed lung, it is done without prior thoracoplasty together with resection of empyema sac if present. Thoracoplasty follows, in three to four weeks, to diminish the size of the pleural cavity

Simple decortication of the lung and chest wall, and occasionally resection of a small parenchymal focus subpleurally is necessary when the ordinary spontaneous tuberculous pleurisy with effusion is not absorbed as usual but goes on *to the development of unexpanded lung* or empyema.

The objections to decortication have been the fear of reactivation of the parenchymal tuberculosis after re-expansion and the fear of chest wall infection resulting from entering tuberculous tissue These complications have been minimized by the use of streptomycin and by obtaining complete re-expansion postoperatively as soon as possible

Technic.—*Streptomycin and PAS are given for at least one week* and penicillin for four days preoperatively Operation is performed under general anesthesia using a posterolateral approach The sixth rib *is resected subperiosteally and a short posterior segment of an* adjacent rib is also resected if the chest wall is rigid. A cleavage plane can usually be developed between parietal peel and chest wall. Decortication *of the normal lung is done in the* usual manner while the lung is partially inflated. Areas of diseased parenchyma previously planned for excision or permanent collapse are not decorticated. Excision *is then* done by individual ligation technic When visible bronchiolar openings are present they are repaired. Adequate drainage of both air and fluid is of utmost importance in achieving *early* and *complete* re-expansion and associated obliteration of pleural space. Postoperatively streptomycin and PAS treatment is continued *for a variable length of time* and penicillin for 7 10 days.

[The authors are wrong in their opinion that total thoracoplasty has not been successful in the treatment of tuberculous empyema. On the contrary some of us pioneers had about 80 per cent successful results with thoracoplasty.—*Ed.*]

Surgical Aspects of Silicotuberculosis have scarcely been examined because surgeons are not familiar with this disease and its incidence varies greatly in different areas. Of 11 published cases of excision of pseudotumors, diagnosis of silicosis *was not considered in 9 although* etiologic, clinical and radiologic factors were in its favor Such errors are

rare now when this form of silicosis is well known Diagnosis is difficult only in rare cases of unilateral pseudotumors occurring late after brief exposure The main problem is therapy A patient with advanced, pure silicosis with extensive bilateral nodular fibrosis or well tolerated pseudotumors may suddenly show signs of progressive tuberculosis forming cavities in the silicotic areas and producing positive sputum This situation is terminal and no therapy is possible

A. Bonniot[7] (Grenoble) attempted excision in seven more benign cases Bilaterality of silicosis associated emphysema and progressive reduction of vital capacity make silicotic patients poor risks moreover nodular fibrosis is often a mixed lesion and after ablation of the active focus other areas may become activated. However in one case in which silicosis had not been diagnosed success of lobectomy led to its further use In this case no clinical nor radiologic signs were present but the lung was black, hard, nonretractile and quite different from what is usually seen in tuberculosis.

All seven patients were miners, aged 25-39 and had unilateral cavities refractory to collapse therapy In all but one radiologic signs were present, minimal in some, characteristic in others There was no relation between extent of microscopic lesion and radiologic picture Only excised tissue was examined. Possibly in some the tuberculous focus was in an area in which silicotic lesions were sparse, whereas in others in which the lesion evolved in a dense silicotic area, the nodules were susceptible to the caseating process. Only a thorough search revealed fibrohyaline nodules These cases suggest that limited silicosis which produces no symptoms and only minimal radiologic signs may yet so change pulmonary tissue that superimposed tuberculosis will give it a peculiar appearance and a rigidity precluding collapse therapy Excision seems justified in such localized cavities.

All but one patient had lobectomy and a smooth postoperative course The one patient who had a pneumonectomy died on the 68th day of a bronchial fistula All withstood operation well and none showed respiratory insufficiency One patient was in excellent condition two years after op-

(7) Lyon chir 47 305 321 April, 1952.

eration The other operations dated back less than a year, *long term results* await further evaluation

Pneumoperitoneum in Tuberculosis S Belbenoit and J Loy[8] (Arras, France) discuss their experience with 100 patients. "Pure" pneumoperitoneum (without phrenic paralysis) may be established alone or with pneumothorax, thoracoplasty or extrapleural pneumolysis Radiologically



Fig 45 —"Pure" pneumoperitoneum, with slight asymmetry from predominance of pulmonary retraction on the left. (Courtesy of Belbenoit, S., and Loy J.: Rev tuberc. 14 1003 1015 1950)

(Fig 45) it produces a gaseous subphrenic accumulation with symmetrical elevation of the diaphragm and conservation of its movements *Diaphragmatic elevation is progressive* Following an initial adaptation period, maximal elevation is obtained and should be maintained by regular insufflations *increased frequency or pressure of insufflations produces no further elevation* This procedure is valuable (1)

(8) Rev tuberc. 14 1003 1015 1950

when pneumothorax is indicated, in which case pneumoperitoneum gives even better results (parahilar cavities) (2) when pneumothorax is indicated but is technically impossible (adhesions), (3) when pneumothorax is not particularly indicated, as in the presence of diffuse, minimal lesions, or when it is dangerous, particularly in the presence of streptococcic pulmonary suppuration, and (4) when pneumothorax has proved unsatisfactory, in which case, pneumoperitoneum may be substituted or combined with the pneumothorax.

In general, one should start with pneumoperitoneum rather than use it only after surgical phrenic paralysis has failed Best results in such surgical paralysis follow preliminary elevation of the diaphragm by pneumoperitoneum if possible only temporary paralysis should be used Sometimes, however, combination of both procedures is justified and effective One patient was cured by successive phrenicectomy, pneumoperitoneum and thoracoplasty Another with bilateral lesions and left retrohilar cavity was cured with pneumoperitoneum followed by phrenic section

Indications for this procedure in certain forms of intestinal and peritoneal tuberculosis are less clear In intestinal tuberculosis, cures and prolonged arrests have been observed, but often the improvement is merely symptomatic, while the pathologic process persists and pulmonary lesions increase Of 22 patients, 1 was cured after five years 7 improved but ultimately had either intestinal or pulmonary relapses. Improvement, if it occurred, was rapid it affected general condition and pains but the vomiting and diarrhea only slightly In two patients with severe intestinal lesions, perforations were observed the procedure is contraindicated, therefore in severe disease In tuberculous peritonitis, pneumoperitoneum is indicated only in the ascitic and the dry forms, provided adhesions in the latter do not preclude it and good results have been noted after its use The fibrocaseous form contraindicates the procedure

Effects of Hypercapnia and Hypoxia on Response of Heart to Vagal Stimulation were analyzed in dogs by W Glenn Young, Jr., W C Sealy, Jerome Harris and Arnold Botwin[9] (Duke Univ) using continuous strong faradic stimulation on the exposed intact right vagus nerve under anesthesia. Varying concentrations of carbon dioxide and/or oxygen were tested as to their effects on arterial pH and duration of cardiac systole While the effects of the faradic stimulation varied considerably from dog to dog, they were constant for each individual dog All animals survived these drastic interferences with respiration.

Hypercapnia, caused by breathing 20 per cent carbon dioxide mixtures with concomitant lowering of blood pH to between 7 0 and 6 6, produced a constant increase in duration of cardiac asystole during vagal stimulation, duration being inversely proportional to the pH. As soon as the dog was given 100 per cent oxygen, rise in pH was accompanied by a decrease in duration of asystole during stimulation until response became normal.

Hypoxia produced by breathing mixtures containing only 10-15 per cent oxygen, decreased the duration of cardiac asystole from vagal stimulation. Furthermore, this diminished effect was maintained even when hypoxia was combined with hypercapnia and low blood pH.

The enhanced effects of vagal stimulation in hypercapnia are in line with the findings of Andrus that the turtle s heart is more sensitive to vagal stimulation in acid mediums. This effect is completely antagonized by hypoxia even in the continued presence of hypercapnia This effect could be due to the pronounced stimulation of the adrenal and sympathetic systems that occurs with hypoxia.

Hypercapnia, which often occurs in open chest operations, may be responsible for increased vagal tone such as is represented by the bradycardia which appears before cardiac arrest. Hypoxia may be of great importance in conditioning the cardiac muscle to eventual failure, even though hypoxia,

(9) Surg., Gynec. & Obst. 93 51 55 July 1951.

as long as it continues, decreases vagal effect. It is believed that these observations clearly show that unless pulmonary ventilation is adequate during anesthesia, the resulting carbon dioxide retention may greatly augment the effect of any vagal stimulation which might occur during operation.

[Of course it is always important for the anesthetist to insure adequate ventilation but especially important in long intrathoracic operations.—Ed.]

Surgical Treatment of Ventricular Fibrillation Julian Johnson and Charles K. Kirby[1] (Univ of Pennsylvania) state that ventricular fibrillation is caused by manipulation of the heart, contact with its conduction mechanism, anoxia, coronary artery disease cyclopropane and other drugs which increase myocardial irritability Sudden disappearance of palpable pulse and audible blood pressure is presumptive evidence of cardiac arrest or ventricular fibrillation. Immediate exploratory thoracotomy is the only reliable diagnostic measure With the heart exposed, characteristic fibrillary twitchings are readily palpable If the ventricles are not contracting effectively, which can be determined within seconds, cardiac massage should be started immediately

Of 10 patients with ventricular fibrillation, 4 recovered. Three were cardiac surgery patients In one, fibrillation began as the left auricular appendage was being prepared for mitral commissurotomy In two ventricular fibrillation developed during cardiac catheterization. In the fourth, cardiac arrest occurred during a Rubin test under general anesthesia. In the four who recovered completely, resuscitative measures were begun within four minutes of onset of ventricular fibrillation or cardiac arrest. Although they have not been tested psychometrically there has been no evidence of deficit in personality or intellect Among the six patients who died, resuscitation efforts were delayed beyond six minutes Four were defibrillated but died later

Seven patients had cardiac arrest as soon as the heart was exposed With cardiac massage there is usually a return to normal rhythm or ventricular fibrillation Not a single heart has remained arrested.

Adequate circulation through cardiac massage and adequate respiration by artificial ventilation of the lungs, must be established within four minutes An immediate attempt

(1) Ann Surg 134 672-682 October 1951

at defibrillation is not advisable since the heart is cyanotic when cardiac massage begins and usually cannot be defibrillated until it is well oxygenated Massage should be rapid, 80-120 contractions/minute, venous return to the heart should be supplemented by moderately rapid intravenous administration of crystalloid solutions and blood, and cerebral circulation may be increased by intermittent occlusion of the thoracic aorta Procaine or pronestyl should be given intravenously to decrease myocardial irritability The most reliable method of stopping ventricular fibrillation is electric shock which produces a strong simultaneous contraction of all in-co-ordinated, fibrillating muscle fibers This is followed by simultaneous relaxation and after a brief pause normal contractions usually begin. The authors use an electric defibrillator (60 cycle alternating current from a wall socket) A current of 1 5-2 amp., with the electrodes in contact, has been adequate The electrodes are pressed firmly against the anterior and posterior walls of the myocardium and three shocks of less than one second duration are thrown into the heart at intervals of about one second. In one patient five series of shock were required. Large hearts are more resistant and the strength of the current must be increased

Simple Electrical Apparatus for Clinical Treatment of Ventricular Fibrillation is explained by William B Kouwenhoven and Jerome Harold Kay[2] (Johns Hopkins Univ)

APPARATUS.—The power unit consists of a 600 watt isolation transformer which separates the grounded power source from the current supplied to the electrodes. Attached is a cord to the wall receptacle with a 120 volt, 60 cycle a-c source. A 5 amp., 0-135 volt variable voltage transformer called a variac usually set at 130 volts, is connected to a foot switch with which the surgeon controls application and duration of the defibrillating shock. The plug attached to the electrode cord is inserted in a Twist Tite convenience outlet. A 6 watt pilot lamp which lights when the foot switch is pressed and a box on which all is mounted (Fig 46) complete the apparatus.

In treatment of ventricular fibrillation, it is most important to massage the heart before electrical defibrillation is attempted. Defibrillation is done by soaking the felt padded electrodes in an isotonic saline solution and placing the electrodes on the right side of the right ventricle immedi

(2) Surgery 30 781 784 November 1951

atel below the right auricular appendage and on the left ventricle at the apex of the heart An electric current is then passed through the heart for one second or less If several shocks fail to defibrillate the heart, it should be massaged for another minute, then serial defibrillation, consting of a series of shocks, passed through the heart, each

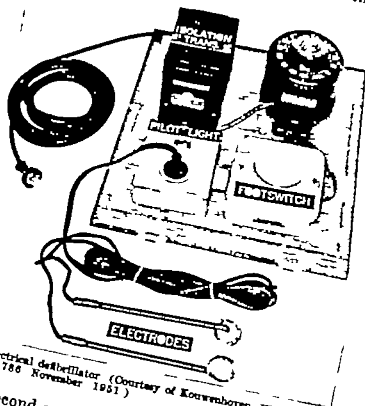


Fig. 46 —Electrical defibrillator (Courtesy of Kouwenhoven, W B. and Kay J H.: urgery 30 781 786 November 1951)

lasting ⅓ second with a ⅓ second interval between shocks, should be tried.

Procaine or other myocardial depressants are not usually necessary If serial defibrillation fails 5 cc of 1% procaine can be injected into the left ventricular cavity, the heart massaged for a minute or two and serial defibrillation again attempted. If the heart does not begin forceful contractions immediately ⅒-⅕ cc of 1 1 000 epinephrine hydrochloride in 5 cc isotonic saline or 2-4 cc of 10% calcium chloride should be injected into the left ventricular cavity and cardiac massage continued. The cardiac stimulants may be repeated every two to three minutes It is necessary to

continue vigorous cardiac massage about 40 times/minute until effective spontaneous cardiac contractions occur

Use of Calcium Chloride in Treatment of Cardiac Arrest in Patients Jerome Harold Kay and Alfred Blalock[3] (Johns Hopkins Univ) found $CaCl_2$ injected into the left ventricular cavity extremely useful in treatment of ventricular standstill arising spontaneously or following successful electrical defibrillation of a heart in ventricular fibrillation. The calcium ion has a direct effect on the myocardium during standstill, thereby increasing excitability and contractility of the ventricular muscle This effect is similar to the accelerator stimulation of epinephrine hydrochloride and the muscular stimulation of digitalis It would seem that $CaCl_2$ may be more effective than epinephrine in ventricular standstill or impending ventricular standstill during operations on patients with congenital heart disease

Injection into the left ventricular cavity appears to be the route of choice since the cardiac massage forces some of the solution directly into the coronary arteries If the left ventricle is inaccessible, an injection into any of the other chambers of the heart followed by massage usually causes cardiac contractions.

Dosage of $CaCl_2$ in children varied from 2 to 4 cc of a 10% solution as a single injection, this may be repeated after two or three minutes if necessary After injection, vigorous cardiac massage must be continued until an effective beat has been restored.

[With good anesthesia and proper attention to ventilation and the prevention of hypoxia there will be fewer cases of cardiac arrest.—Ed.]

Recent Advances in Development of Mechanical Heart and Lung Apparatus Bernard J Miller John H. Gibbon, Jr., and Mary H. Gibbon[4] (Jefferson Med. College) developed an improved blood oxygenator consisting of six stainless steel screens in parallel, suspended from a distributing chamber and enclosed in a clear plastic case. With this oxygenator in an improved extracorporeal blood circuit, cardiorespiratory functions were maintained in 21 dogs during occlusion of the venae cavae The mechanical heart and lung apparatus was maintained in the animals for 20-96 minutes. There were 14 deaths 7 animals died of such obvious causes

(3) Surg., Gynec. & Obst. 93:97-102, July 1951
(4) Ann. Surg. 134:694-708, October 1951

as hemorrhage, postoperative thrombosis, hemolysis, distemper and inadequate oxygen saturation causes of death in the other 7 were not as obvious One died of distemper on the 19th day The other six all had low circulation rates during the perfusion period and may have had cerebral anoxia despite adequate saturation of venous blood.

The blood flow in ml./kg body weight/min. in the seven that lived through the perfusion ranged from 83 to 124 averaging 101 This flow is 50% above that obtained in six of the seven animals which died without obvious cause after perfusion. The oxygen saturation of venous blood was low (34-43%) in three animals and normal in four The degree of hemolysis in five of the seven survivors was within tolerable limits

The most successful experiment was maintenance of cardiorespiratory functions by the mechanical apparatus for 96 minutes Blood pressure was well maintained throughout occlusion of the venae cavae Blood flow through the extracorporeal circuit remained constant at 1 180 ml./min. The pH of the blood leaving the oxygenator was maintained within normal limits, indicating adequate removal of carbon dioxide Oxygen saturation of venous blood remained above 60% indicating adequate tissue oxygenation.

The next experimental step will be to demonstrate that operations can be performed within the opened heart under direct vision.

[It is to be strongly hoped that Gibbon succeeds in making his apparatus fool-proof. Many kinds of intracardiac operations not now performed will be made possible with such an apparatus.—Ed.]

Consideration of Some Problems in Cardiovascular Surgery Alfred Blalock[5] (Johns Hopkins Univ) reviews the progress made and assesses the value of operative procedures used in cardiovascular diseases, excluding peripheral vascular diseases and portal hypertension. The disorders are classified in three groups (1) Acquired lesions in which surgery may accomplish good or excellent results are constrictive pericarditis, wounds of the heart, systemic arteriovenous fistula arterial aneurysm and mitral stenosis Congenital lesions in which good or excellent results may be obtained are patent ductus arteriosus, coarctation of the

(5) J Thoracic Surg 21 543 5 1 June 1951

aorta, pulmonary stenosis and atresia, pulmonary arteriovenous fistula and anomalies of the aortic arch (2) An acquired lesion in which surgery may bring about moderate improvement is essential hypertension. Congenital lesions in which moderate improvement may be obtained are *transposition of the aorta and pulmonary artery* and anomalies of venous return. (3) Acquired lesions in which surgery is of doubtful value or suitable methods are not fully developed are coronary arterial disease, aortic valvular stenosis, insufficiency of heart valves and intracardiac tumors. Such congenital lesions are anomalous origin of left coronary artery auricular septal defects, Lutembacher's syndrome, ventricular septal defects, Eisenmenger's complex and pul*monary hypertension.*

Most conditions amenable to surgery are of congenital or traumatic origin. Much progress remains to be made in acquired and degenerative heart disease Good results, however, are obtained in two acquired conditions, constrictive pericarditis (usually of tuberculous origin) and mitral stenosis resulting from rheumatic disease

Improvement in homografting of tissues and further methods to control infection would expand the field of cardiovascular surgery A bloodless field is highly desirable. Successful development of a pump-oxygenator for maintaining *the patient* without the functioning of his own heart and lungs will allow great advances in cardiovascular surgery

Cardiac Surgery is discussed by R. C Brock[6] (London) from the standpoint of both indirect and direct operations on the heart.

Four conditions call for indirect surgery (1) cardiac ischemia, (2) constrictive pericarditis, (3) aortic coarctation and (4) patent ductus arteriosus In general the methods used for cardiac ischemia—anastomosis between the heart and adjacent structures and/or encouraging free intercoronary *anastomosis—have not proved acceptable* Interruption of afferent sympathetic nerve pathways, however, either by resection of the upper four thoracic ganglions or by resection of nerve fibers crossing the aortic arch, seems promising in allaying vascular spasm and pain. Although *the heart is normal in constrictive pericarditis*, its action is

(6) Ann. Roy Coll. Surgeons England 9:1 12, July 1951.

hindered until pericardectomy is done, preferably with a median sternotomy which exposes the right atrium, the venae cavae and the ventricles Resection and anastomosis (10% mortality) for aortic coarctation is done to reduce hypertension in the cephalad part of the body with its dire results. Patent ductus arteriosus eventually produces heart failure because of heart strain through arteriovenous leak and therefore demands closure (mortality rate only 1 2%)

Direct heart surgery is indicated for (1) mitral stenosis, (2) cyanotic heart disease, (3) pulmonary valvular stenosis, including tetralogy of Fallot when due to pulmonary valvular stenosis and (4) infundibular stenosis It is facilitated by newer developments in intrathoracic technic, anesthesia, blood transfusion, oxygen administration, antibiotics, procaine given intravenously to diminish excitability of the heart and consequent arrhythmias and local use of anesthetic solutions in adjacent nerve plexuses, in the pericardial sac and in the myocardium.

Mitral stenosis can now be relieved by a relatively safe procedure Brock operated on 50 patients with eight deaths and no death in the last 27 consecutive operations. The stenosed orifice is enlarged along the lines of the commissures to avoid injury to the large anteromedial and smaller posterolateral cusps The valve is approached through the left auricular appendage with little blood loss and is usually simply and safely split along one or both commissures with the finger although in a small proportion of cases a valvulotome is needed to begin or complete the division. Old fibrous or recent clot is often encountered in the auricle and must be carefully removed. By momentary release of the clamp on the base of the auricle the efflux of blood will wash out any fragments. A clot not removed may become an embolus It is important at the end of operation to examine all limb vessels for pulsation. Auricular fibrillation, though undesirable does not contraindicate surgery (5 deaths in 22 cases) The ideal age for operation is 20-45 Active rheumatism is a contraindication at any age but is especially likely to be present under age 20 even though not always recognized. The author's oldest patient was 50 Operation is contraindicated in gross cardiac enlargement

especially if associated with marked mitral regurgitation or aortic disease Symptoms of pulmonary congestion or hypertension (including orthopnea, cardiac asthma hemoptysis and recurrent attacks of pulmonary edema or "bronchitis") and a small or not greatly enlarged heart constitute the best indications for operation

Cyanotic heart disease caused by arteriovenous mixing and/or inadequate blood flow to the lungs from pulmonary stenosis is improved by anastomosing a systemic artery to a pulmonary artery either using the subclavian artery (Blalock and Taussig) or aortic pulmonary anastomosis (Potts) However it must be realized that excellent as re-

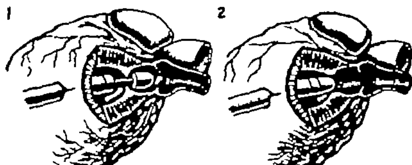


Fig. 47—Infundibular punch resection. (Courtesy of Brock, R. C. Ann. Roy Coll. Surgeons England 9 1 12 July 1951)

sults have been, the cyanosis is relieved by shunting more unoxygenated blood into the lungs rather than by actually correcting the anatomic abnormalities. It is to be hoped that direct attack on the pulmonary valvular stenosis may restore the heart to a more normal state The patient's status should be thoroughly studied before surgery to determine whether relief is possible

Valvulotomy for pulmonary valvular stenosis produces direct relief of obstruction. Whatever may be the position of the Blalock and Potts operations in Fallot's tetralogy, they should not be done in patients with pure pulmonary valvular stenosis with closed septa When such an anastomosis has been done in error the situation can be retrieved by valvulotomy and closure of the anastomosis. Pulmonary valvulotomy is relatively simple and safe provided it is done before the patient is in heart failure or ill with a huge heart and scarcely any reserve The pulmonary valve is ap-

proached through an incision in the wall of the right ventricle, divided by a special valvulotome and split widely by graduated bougies and an expanding dilator In many almost symptomless children and young adults, catheterization reveals right ventricular hypertension (e g., 200 mm. Hg), and in these patients valvulotomy prevents later deterioration and death. In Brock's last 50 cases, a valvular stenosis was present and valvulotomy was done in 22 Results were excellent in most, particularly in children. The site and nature of the stenosis can be fairly accurately diagnosed preoperatively by clinical and x ray studies, reinforced by angiocardiograms and cardiac catheterization.

Infundibular stenosis is an obstruction below the level of the pulmonary valve and constitutes the stenosis in 60% of the cases of tetralogy of Fallot The obstruction may be (1) just below the valves (high), (2) 1 2 cm. down (intermediate) or (3) lower still (low) In the latter two forms there is usually poststenotic dilatation which gives rise to an infundibular chamber that is recognized radiologically and at operation. Resection was done in 24 patients by inserting a special punch through an incision in the wall of the right ventricle (Fig 47) There were seven deaths Four patients had a successful combined infundibular resection and valvulotomy

Although anastomosis is essential in pulmonary and/or tricuspid atresia, is probably preferable in patients over age 20 with Fallot's tetralogy and may be preferable in high infundibular stenosis, direct operation whenever possible is recommended in Fallot's tetralogy Of a total of 176 operations for morbus caeruleus, Brock performed an anastomosis in 106 and direct operation in 70 However in the most recent 50 cases, he has used direct operation in 27

[Brock's operation for pulmonary valvular stenosis is brilliant and logical in conception and, as shown in the abstract, gives excellent results.—Ed.]

Surgical Treatment of Constrictive Pericarditis Clinical and Experimental Observations are reported by Emile Holman[7] (Stanford Univ)

Constrictive pericarditis is often long unrecognized, masquerading as rheumatic heart disease, tuberculous peritonitis or cirrhosis of the liver Constrictive pericarditis should

( ) Ann. Roy Coll. Surgeons England 9.309 317 November 1951.

be strongly suspected in the young person with apparently normal heart who has symptoms of circulatory failure such as ascites pleural effusion, peripheral edema quiet or muffled heart sounds *without murmur*, *cardiac borders* with little motility under fluoroscopy, low arterial pressure and small pulse pressure venous pressure above 15 cm. of water in the arm and possibly 5-10 cm higher in the leg and a low voltage electrocardiogram with inverted T waves.

Febrile illness with pericardial effusion and large cardiac shadow, followed by reduction in the cardiac area, with signs of increasing cardiac failure (ascites, pleural effusion and increased venous pressure) strongly indicate development of heart compression resulting from contraction of an *inflamed and fibrous pericardium.*

The relentlessly progressive character of tuberculous pericarditis from its onset, with chills, fever, sweats and pericardial effusion, to later reabsorption, but with evidence of increasing constriction by an inflamed and fibrous pericardium, *demands surgery at the first sign of cardiac compression*. Whenever such compression can be demonstrated, be it in the stage of pericardial effusion or in the stage of pericardial contracture, there is great need of prompt cardiac decompression. In an ill patient with tuberculous pericardial effusion such decompression might best be effected by removal of the left sixth costal cartilage for evacuation and drainage of the pericardium, followed at a second stage 10-20 days later by median sternotomy and extensive pericardiectomy All operative areas healed per primam (with the aid of dihydrostreptomycin) in five of the authors patients, despite active tubercle bacilli in the pericardium.

In constrictive pericarditis the extent and site of compression by thickened pericardium varies from patient to patient. To insure adequate liberation of the heart all borders of the pericardium must be freed routinely The pericardium must be excised beyond the left, right and inferior borders with both venae cavae liberated to insure prompt fall of venous pressure and to obviate a second operation. *Experimentally constrictive pericarditis symptoms* have been produced by compression of the right heart, inferior and/or superior venae cavae

Pericardiectomy is done by limited median sternotomy

from xiphisternum to second intercostal space because it provides the necessary exposure for extensive decortication and ensures safer surgery under direct vision with less danger of injury to the thin walled and fragile right auricle

Factors in Selection of Cases for Surgery on Heart Valves According to E Cowles Andrus[8] (Johns Hopkins Univ) selection of cases of mitral stenosis in which favorable results may be expected rests primarily on appraisal of the dynamic consequences of mitral obstruction Physical signs of mitral stenosis alone are not an indication for surgery However, in most cases pulmonary engorgement becomes progressive and disabling Operative mortality from mitral valvulotomy is 12% or less

Indications for surgery are progressively severe dyspnea on exertion or excitement, cough or pulmonary edema following effort or excitement, sometimes accompanied by the raising of foamy, pink sputum, paroxysmal dyspnea at rest (often at night), orthopnea, and hemoptysis Bleeding evidently occurs from bronchial vein varices which afford channels between the pulmonary and systemic venous systems and is a sign of a critical rise of pulmonary venous pressure If cardiac catheterization shows the pulmonary artery pressure to be low (and by implication, not irreversibly fixed) a raised "capillary" pressure will usually respond to surgery Diminished resting arterial oxygen saturation suggests that fixed changes in the alveolar walls interfere with diffusion. Sometimes rapid progress toward irreversibility is made in a year or two, particularly after auricular fibrillation sets in.

Contraindications to surgery are active rheumatic carditis bacterial endocarditis, intractable right heart failure frequent or recent embolism, especially after prolonged auricular fibrillation, mitral insufficiency and lesions of other valves, particularly aortic stenosis.

Surgical Treatment of Cardiac Valvular Stenosis William H. Muller, Jr., and W P Longmire Jr[9] (Univ of Calif) operated on five patients with pure pulmonary stenosis by the method of Brock. An adjustable valvulotome with three cutting blades was used satisfactorily in the last

(8) M. Ann. District of Columbia 21 77 79 February 1952.
(9) Surgery 30:29-42 July 1951

two patients, dilatation of the incised valve was accomplished by an expansible dilating instrument.

TECHNIC.—With quinidine preoperatively and under cyclopro-

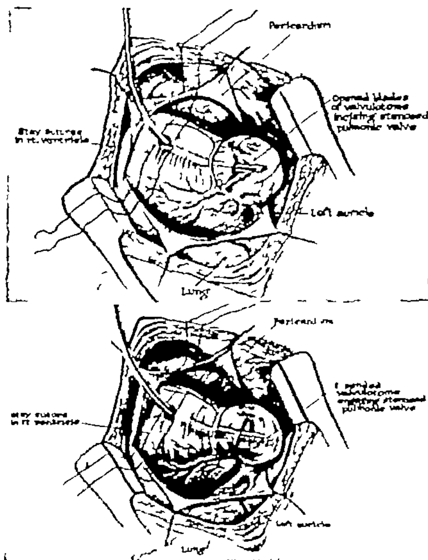


Fig 48 (top) —Operative procedure for pulmonic valvulotomy with valvulotome introduced through stab wound in right ventricle and open blades incising stenosed pulmonic valve.
Fig 49 (bottom) —Expansible dilator introduced through stab wound in right ventricle and engaging and dilating incised pulmonic valve.
(Courtesy of Muller W H J and Longmire W P., J Surgery 30:29-42, July 1951)

pane, oxygen and ether the patient is placed in the supine position and the chest entered *through the left fourth intercostal space* About 10 cc. of 4% procaine is injected into the pericardial cavity the pericardium is incised 1 cm. anterior to the phrenic nerve and

procaine is injected into the right ventricular wall about 2 cm. from the origin of the pulmonary artery and two stay sutures are placed in the ventricular muscle. With a sharp pointed knife an incision is made through the full thickness of the ventricular wall and the valvulotome is then slipped into this opening. The stenosed orifice is usually located easily. The blades are opened slightly to a cutting position and the leading end of the instrument is pushed through the stenotic valve. The end of the instrument is withdrawn into the ventricle, the blades are opened wider and the valve is again incised (Fig. 48). The expansible dilator is then inserted and the incised valve is dilated (Fig. 49). The dilator is withdrawn and the incision in the ventricle is closed with interrupted silk sutures.

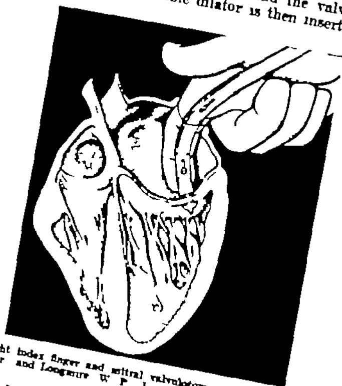


Fig. 50.—Right index finger and mitral valvulotome in left auricle. (Courtesy of Muller, W. H., Jr. and Longmire, W. P., J. Surgery 30: 29-42, July 1951.)

All five patients improved after valvulotomy. The thrill over the main pulmonary artery became less intense after surgery. The degree of pulmonic insufficiency produced is not a serious problem. Considerable time must elapse before the ultimate benefit of this procedure can be evaluated.

Fourteen patients were operated on for mitral stenosis by the Bailey technic of commissurotomy. A valvulotome (a modification of the Bailey instrument) with a hooked knife on either side and designed to obviate the necessity for a second glove was devised.

TECHNIC.—After the heart is exposed, as described above, a purse-string suture of 00 silk on an atraumatic needle is placed about the auricular appendage at its junction with the chamber of the auricle. The auricle is temporarily occluded by a special noncrushing clamp and the tip of the appendage is excised The finger is then introduced into the auricle, the valve palpated and the finger passed into the valve opening, which is then moderately dilated. The valvulotome is passed into the auricle along the finger (Fig 50), and the anterolateral commissure is engaged first and divided. The valvulotome is then moved to the right and the posteromedial commissure is engaged and divided The incised areas are then dilated. The finger is withdrawn, the purse-string suture tightened and the cut end of the auricle oversewn with an arterial suture

There were three deaths. One died of a pulmonary embolus, another of cardiac arrest at the operating table, and the third of auricular fibrillation and heart failure on the fourth postoperative day All surviving patients have improved subjectively The most suitable patients for this surgery are young people with increasing exertional dyspnea and easy fatigability only, rather than persons with advanced pulmonary hypertension. Only aortic insufficiency severe enough to produce peripheral signs should contraindicate operation. The authors have not been able to establish definite criteria for the selection of patients

Surgical Treatment of Pulmonary Stenosis with Intact Interventricular Septum. Willis J Potts and William L. Riker[1] (Chicago) performed valvulotomy on 13 patients, aged 23 days to 17 years This condition, designated pure pulmonary stenosis, is due to fusion of the pulmonary valve cusps and is not the infundibular type usually encountered in tetralogy of Fallot It is almost always accompanied by low pressure in the pulmonary artery and poststenotic dilatation. There is little cyanosis relatively as compared with tetralogy of Fallot however in all but 1 of the 13 patients it was visible. At operation, palpation conveys to the finger a feeling of increased pressure in the hypertrophied right ventricle and decreased pressure in the dilated pulmonary artery, whereas blood rushing through the stenosed valve produces a palpable high pitched systolic thrill. The liver is often enlarged and sometimes pulsation is present In the patients on whom cardiac catheterization was done, it showed high right ventricular and low pulmonary pressure Angiocardio-

(1) A.M.A. Arch. Surg 62 776-784 June 1951

grams were not made of patients in a precarious condition. Erythrocyte count averaged 6,300 000 The shunt operation may increase the already excessive strain on the right side of the heart The valvulotome and dilator used are shown in Figures 51-53

TECHNIC.—Morphine and scopolamine are given preoperatively Cyclopropane anesthesia is used, with small amounts of ether Fluid and/or blood is injected in the saphenous vein as necessary The patient lies on a water mattress, the temperature of which is regulated so that when he becomes more cyanotic, a cooling effect can be produced, this lowers the rate of oxygen consumption and thus

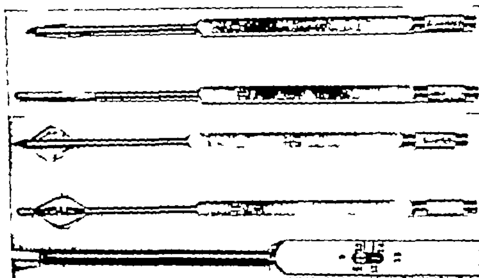


Fig. 51 (top) —Valvulotome and dilator closed.
Fig 52 (center) —Opened.
Fig. 53 (bottom) —Enlarged photograph of indicator
(Courtesy of Potts, W J., and Riker W L. A.M.A. Arch. Surg. 62:776-784 June 1951)

lessens hypoxia. A rectal thermocouple allows continuous observation of body temperature.

A curved submammary incision is made beneath the left nipple (Fig 54, *A*) The pectoralis major muscle is reflected upward and the chest is entered through the third intercostal space (*B*) The second, third and fourth ribs are cut at the costosternal junction. Five cc of 1% procaine hydrochloride is introduced into the pericardium through a small opening and left in the sac for five minutes. The pericardium is then opened longitudinally anterior and parallel to the phrenic nerve

Two cc of 1% procaine is injected into the wall of the right ventricle at the site chosen for introduction of a valvulotome. Two holding sutures (large bite) of 4-0 Deknatel silk on a curved swaged-on no. 44 needle are introduced into the wall of the right

ventricle. A tiny transverse incision is made part way through the musculature between the sutures. The valvulotome, completely closed, is thrust into the right ventricle and guided to the stenotic valve by palpation (*C*) The approximate diameter of the constricted pulmonary artery is estimated by direct vision and palpation. The valvulotome is opened to that size (Fig 55, *E*), thrust through the fused pulmonary valve and withdrawn into the ventricular chamber (*F*) It is then closed and withdrawn. The index finger controls bleed

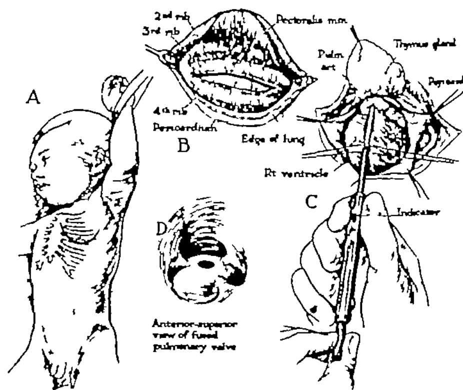


Fig. 54 —Surgical technic for pulmonary stenosis with intact interventricular septum and fused pulmonary valve. (Courtesy of Potts, W J., and Riker W L A.M.A Arch. Surg 62 776-784 June 1951)

ing until the dilator is introduced (*G*) and opened as widely as the caliber of the pulmonary artery allows (*H*) The dilator is closed (*I*) and withdrawn after insertion of sutures for promptly closing the ventricular incision The pericardial sac is left open near the apex to prevent accumulation of fluid. The chest is drained through the fifth interspace. The wound is closed in layers.

Results were excellent in 11 patients and fair in 1. In one infant the heart stopped beating on the operating table and he died.

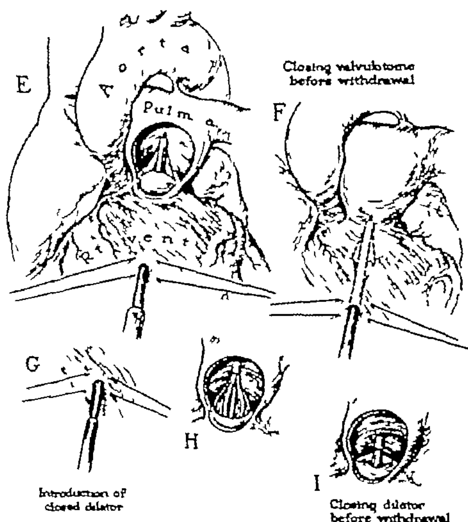


Fig. 55.—Surgical technic for pulmonary stenosis (cont.) (Courtesy of Potts, W. J., and Riker W. L. A.M.A. Arch. Surg. 62:776-784, June, 1951.)

Surgery of Mitral Stenosis III. Finger Fracture Valvuloplasty According to Dwight E. Harken, Lewis Dexter, Laurence B. Ellis, Robert E. Farrand and James F. Dickson[2] (Boston) the major leaflet of the mitral valve exercises a baffle effect or acts as a watershed in the outflow tract of blood to the aorta, whereas the lesser leaflet has no such function. Major leaflet defects are badly tolerated because of severe regurgitation, whereas defects of the lesser leaflet are well tolerated. There are four factors in closure of the

(2) Ann. Surg. 134:722-742, October, 1951.

mitral valve (1) a simple flutter valve mechanism of closing the mitral leaflets during systolic elevation of pressure in the ventricles, (2) sealing by broad apposition of the sides of parachute like leaflets, (3) torsion of the chordae tendineae, (4) contractility of the annulus of the mitral valve The flutter valve closure mechanism is re-established by mitral valvuloplasty The second and third mechanisms may be restored to a greater or lesser degree, depending on extent of the pathologic process at the time of surgery Extent to which the fourth mechanism operates in diseased valves has not been determined

In the type 1 pathologic process there are bridges of fusion between the major and minor leaflets that constitute a rigid zone which is in continuity with a similar rigid marginal zone around the lips of the stenotic orifice. There may or may not be calcific deposits in these areas The chordae tendineae and papillary muscles are normal The major leaflet is intact and is usually flexible in its proximal two-thirds Valvuloplasty can correct stenosis by breaking the anterior and posterior fusion bridges, which releases the leaflets so that they swing freely on the flexible proximal portion. Minor degrees of regurgitation are also corrected. Over 80% of mitral stenosis is of this type In type 2 a uniform fusion presents an elastic funnel formation with extension of the process to the chordae tendineae They are shortened thickened, fused and may even form a secondary stenotic opening Finger fracture valvuloplasty is usually not applicable and incisional valvuloplasty with valvulotomes must be done Stenosis of either type 1 or 2 may in volve orifices of similar size but nevertheless be associated with different degrees of regurgitation, depending on the direction that the mitral opening faces. If the funnel is turned toward the ventricular wall, the opening may be closed in systole by the myocardium and thus prevent regurgitation. If the mitral orifice points into the outflow tract it will scoop blood in systole with resultant regurgitation.

Tachycardia must be avoided during surgery If necessary 0.25 mg prostigmin* may be given intravenously To prevent hypotension, blood transfusions and intravenous administration of neo-synephrine* may be of value ECG s are

made throughout surgery If they show excessive cardiac irritability 20-40 mg procaine is given intravenously or 100 mg procaine amide

TECHNIC.—Under general anesthesia an incision is made over the left third interspace in a crescentic fashion from the sternum to a point high in the left axilla. The third interspace is entered, lung retracted and upper part of the pericardium over the left auricular appendage seen. Condition of the pulmonary artery and lung is noted A small incision is made in the exposed pericardium just anterior to the phrenic nerve, 3 or 4 cc. of 1% procaine is injected into the pericardial sac. The index finger of the left hand is inserted into this initial pericardiotomy site and the major pericardial incision is made as a counterincision 2 cm. posterior to the phrenic nerve This incision is carried parallel to the phrenic nerve and posterior to it, over a distance of about 10 cm. The auricular appendage is then palpated and if not grossly filled with clot, the tip is grasped lightly with an auricle clamp and opposing purse string sutures of oiled no 0 braided black silk on polished, round, atraumatic needles are inserted. The top of the appendage is amputated and cleaned of all trabeculation. A clamp is placed on each side of the opened base and the tip of the right index finger inserted in the left auricle. The anesthesiologist occludes the carotid arteries momentarily to prevent any emboli from reaching the brain.

Once the exploring finger is in the auricle the position of the stenotic funnel is determined, character and type of stenosis is assessed degree of regurgitant jet is evaluated, and mobility and flexibility of the major leaflet are determined. Gentle pressure is then exerted in a posterolateral direction to effect fracture of the posterior fusion bridge. Gentle anterolateral pressure will then effect fracture of the anterior fusion bridge with much less difficulty A careful appraisal is made of the mobility of the major leaflet and its competence in closing the mitral orifice in systole. Every three or four seconds the finger should be removed from the mitral orifice to allow circulatory recovery

If type 2 mitral stenosis is encountered and the elastic fusion bridge resists fracture efforts, the finger is advanced further into the ventricle and an attempt is made to fracture the lesser leaflet in a counterclockwise direction. If this fails incisional valvuloplasty must be done with a valvulotome

As the finger is withdrawn, the opposing sutures are pulled taut and hemostasis is effected. The base of the appendage is oversewn Gelfoam is placed over the stump blood is aspirated from the pericardium, 1 Gm. streptomycin and 1 000 000 units of penicillin are instilled into the pericardial sac, and marsupializing sutures are used to close the pericardium. The chest is closed as usual.

Postoperatively there is considerable improvement in size of the mitral orifice, blood flow and pressures in the various components of the heart and lung It is doubtful if the steno-

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sis recurs since the leaflets are apart longer in diastole than they are together in systole

Of 86 patients who had various operations for mitral stenosis 71 had finger fracture valvuloplasty The patients were classified in four groups Group 1 and 2 patients had mild symptoms In group 3 patients the disability was progressive, with increasing dyspnea, hemoptysis, chest pain, pulmonary edema, palpitations, tachycardia and enlarged liver Group 4 was the terminal group, they had right ventricular failure, elevated venous pressure and enlarged liver Many had had emboli, were in auricular fibrillation and had poor liver function One of the 37 patients in group 3 died. Of the 34 patients in group 4, 17 died Clinical results in group 3 were dramatic and the operation is being considered for those in group 2

Contraindications of surgery are active rheumatic carditis, multivalvular disease, severe mitral regurgitation, and aortic stenosis and regurgitation.

Valvotomy for Mitral Stenosis Further Report on 100 Cases, with detailed analysis of the first 50, is presented by Charles Baker R C Brock Maurice Campbell and Paul Wood[3] (Guy's Hosp., London) Before surgery all were seriously disabled Patients with mitral regurgitation or aortic valvular disease as predominating were not included, although such lesions were additional in 5 of the 50 At least 13 had had congestive failure four fifths were aged 25-45 Patients under 25 must be cautiously evaluated to eliminate rheumatic activity Patients past 45 were considered poorer risks. Auricular fibrillation greatly enlarged heart, previous embolism and calcification of the mitral valve did not contraindicate surgery However auricular fibrillation and lengthy congestive failure indicate that the ideal time for help by valvotomy has passed Cardiac catheterization with measurement of right atrial pulmonary artery and pulmonary capillary pressures and cardiac output at rest, and measurement of pulmonary artery pressure and cardiac output during standard exercise test was performed on 99 patients. Catheterization studies were also performed postoperatively

Surgical results were good or excellent in 32 of the first

(3) Brit. M. J 1 1043 1055 May 17 1952

50 patients Two thirds of them resumed work and could walk 2 miles or more Improvement is often dramatic, particularly as 30 of the patients were completely and 19 severely incapacitated preoperatively Of the first 100 patients, 13 died, 7 of them among the first 20 cases treated.

A nearly straight horizontal incision with entry into the chest through the fifth interspace is preferred. The valve is approached by inserting the index finger through the left auricular appendage The valve is actually split, not merely stretched or dilated, along the line of one or both commissures. In 28 patients the valvulotome was used in 9, the little rather than the index, finger was used. Thrombosed auricle complicates operation but, by careful dissection, the thrombus can be freed and entry accomplished.

Auricular fibrillation was associated with higher mortality 8 deaths in 44 as against 5 in 56 without fibrillation. Mitral regurgitation is not increased by successful operation mitral regurgitation, calcification of the mitral valve, or functional tricuspid regurgitation does not prevent good results. Valvotomy was successful in three women during pregnancy which then terminated normally It can therefore be considered the alternative to termination of pregnancy and sterilization Although the follow up has been two to three years at most improvement appears permanent fibrosis or recurrent carditis leading again to severe stenosis of the mitral valve has not been observed

Commissurotomy in Mitral Stenosis Conrad R Lam[4] (Henry Ford Hosp) used Bailey's method on 19 patients aged 20-53 Only 10 had had rheumatic fever All had disabling symptoms of mitral heart disease typical murmurs and enlarged pulmonary conus, left auricle and right ventricle Eight had auricular fibrillation At surgery stenosis was the predominating lesion of the mitral valve in 17 but 2 of these had significant regurgitation. Two patients had gross regurgitation and little stenosis.

TECHNIC—Under pentothal • nitrous oxide-oxygen anesthesia, an incision is made over the third rib on the left side of the chest, and the rib is removed. The pleura is opened and the second and fourth cartilages are divided. The pericardium is incised posterior to the phrenic nerve and 2 per cent procaine (a few cubic centimeters) is injected into the pericardial sac The pericardial sac is opened

[4] A.M.A. Arch. Surg. 63 349-361 September 1951

and procaine is injected subepicardially around the base of the auricular appendage Two purse-string sutures of silk on atraumatic needles are placed well down on the appendage. Precommissurotomy pressures are then made with needles in the pulmonary artery and left auricle. A noncrushing clamp is placed on the auricle and the tip is amputated to permit introduction of the right forefinger and the Bailey-Glover O'Neill *commissurotomy knife, which for reasons* of hemostasis is passed through an opening in the palmar surface of a second rubber glove and out through the opened end of the glove finger Bleeding from the auricle is prevented by tightening one of the purse-strings around the operator's finger Bleeding from the hole in the outer glove from which the knife emerges is con

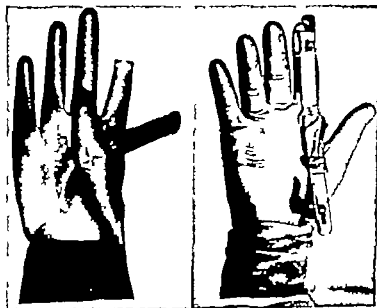


Fig 56 (left) —Six fingered glove for use with commissurotomy guillotine. Fig. 57 (right) —Sixth finger forms tunnel through which knife is inserted. (Courtesy of Lam, C. R.: A.M.A. Arch. Surg. 63:349-361 September 1951.)

trolled by adding a sixth finger to the outer glove (as designed by Dr Edward R. Munnell) in the region between the thenar eminence and the forefinger, forming a tunnel through which the knife is inserted and to the end of which a tight ligature is applied (Figs. 56 and 57)

With the finger in the auricle and the purse-string tightened, the mitral orifice is explored, regurgitation is detected and the general characteristics of the valve, including calcification are noted. The degree of eccentricity of the valve opening gives the indication for medial or lateral commissurotomy or both. Before the knife is used, cautious attempts are made to fracture the commissures with the finger The closed guillotine is inserted in the valve with the hand in complete supination. The guillotine is opened and the blade

caused to catch on the edge of the valve exactly at the commissure if possible. The valve is then cut with a sawing motion or by closure of the guillotine. After completion of the lateral commissurotomy, the hand is pronated and medial commissure cut if necessary. After commissurotomy, the finger and knife are removed and the distal purse-string is tightened and tied. Hemostasis is rarely complete, and a running suture is placed over the defect in the appendage. Postcommissurotomy pressures in the pulmonary artery and auricle are taken. The chest is closed in the usual manner.

Of 15 patients with pure mitral stenosis, 12 had good or excellent results, 1 was temporarily improved and 2 died 'n the immediate postoperative period. There were five leaths, and a review of the circumstances indicates that ase selection was an important factor in the unfortunate esults. Of the patients who died one had persistent regur tation, one, terminal heart failure, one was 53 with hy rtension and mitral regurgitation, and one had adhesive pericarditis with regurgitation. In the two patients with poor results, more extensive commissurotomy would have been beneficial.

Further knowledge of case selection should result in a low mortality after commissurotomy by the auricular approach and a high percentage of improvement in persons disabled with mitral stenosis.

Surgical Treatment of Transposition of Pulmonary Veins. William H. Muller Jr.[5] (Univ. of California) states that the developmental aspects of this anomaly are not completely understood. According to Patten, anomalous connections of the pulmonary veins originate in extremely early embryonic stages in which the developing foregut, trachea and lung beds are supplied by a complex of small channels. These channels pass in all directions through the mesenchyma and join the primitive cardinal veins in many places. When certain of the channels enlarge to form pulmonary veins leading to the left atrium, the primitive connections with the cardinal veins usually disappear. The unusually strong development of one of these early channels and persistence of its embryonic venous connection are responsible for formation of the abnormal communications. Partial anomalous drainage of the pulmonary veins occurs more often than total anomalous drainage into the right side

(5) Ann. Surg. 134: 683-693, October, 1951.

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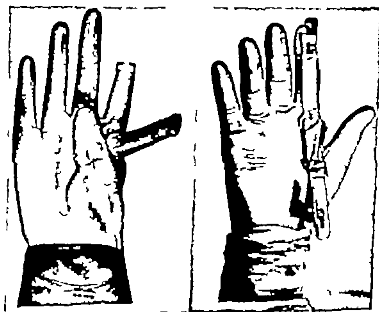


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(5) Ann. Surg. 134: 683-693, October, 1951.

of the heart The right pulmonary veins are affected about twice as often as the left ones The superior vena cava is the commonest point of anomalous entry Other points of entry in order of frequency are the right auricle and left innominate vein Less commonly, anomalous pulmonary veins drain into the coronary sinus, inferior vena cava, hepatic veins, azygous vein, left subclavian vein and anomalous left superior vena cava

The usual anatomic structure of the completely transposed pulmonary venous system is as follows. The superior and inferior pulmonary veins on each side form a common trunk. This trunk in turn unites with a similar trunk on the opposite side to form a common vessel, which enters the right auricle or one of its tributaries

Partial drainage of the pulmonary veins into the right side of the heart is entirely compatible with life Total anomalous drainage is not tolerated well Partial transposition is likely to be associated with a patent foramen ovale and complete transposition must be accompanied by a patent foramen ovale or by a common auricle if life is to exist. In partial transposition diagnosis may be extremely difficult, whereas in complete transposition it may present fewer problems During cardiac catheterization the catheter passes directly into the right lung field from either the superior vena cava or right auricle Complete transposition may be suspected when oxygen content of the blood in the right auricle, right ventricle and a peripheral artery are the same. Angiocardiography may be of value in demonstrating other deformities such as septal defects but the anomalous veins are usually not disclosed

If anomalous venous drainage is on the left only the anatomic relation of the left auricle to the pulmonary vein on that side makes anastomosis feasible between the two structures. When there is complete anomalous drainage the same relation is present between the left anomalous venous trunk and left auricle and a similar anastomosis may be carried out At the same operation or in a later one the opposite side might be explored the common point of anomalous entry closed and the entire pulmonary venous return directed to the left auricle

When the veins are transposed only on the right, the

problem is greater The initial exploration should be performed on the left regardless of which veins are thought to be transposed, because it is impossible to be sure of the configuration on the left If transposition of the veins on the right is demonstrated before the operation, at least partial transposition of those on the left must be present to produce severe symptoms Anastomosis between anomalous right pulmonary veins and the posterior aspect of the left auricle, or homologous graft of vein or aorta, is not

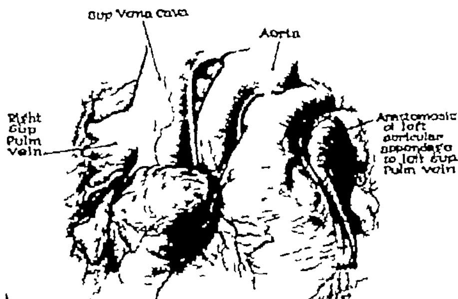


Fig 59 —Anastomosis for transposition of pulmonary veins. (Courtesy of Muller W H, Jr: Ann. Surg 134:683-693 October 1951)

technically feasible When *only one vein enters the right* auricle, operation is impossible

It is difficult to predict the long term benefits a patient with *complete transposition of* the pulmonary veins might derive from surgery Duration of life would be similar to that of a patient with a large atrial septal defect The patent foramen ovale might become smaller with the increased venous return to the left auricle

CASE 1 —Girl, 4, had frequent upper respiratory infections associated with cyanosis, congestive heart failure and poor exercise tolerance Examination revealed an enlarged heart, clubbing of the fingers and toes, and cyanosis. During cardiac catheterization the catheter entered the pulmonary vein. Fluoroscopy revealed enlargement of the hilar vessels with vigorous expansile pulsations. An ECG

revealed pronounced right axis deviation. Complete transposition of the pulmonary veins was diagnosed when oxygen content of the blood in the right auricle, right ventricle and femoral artery was shown to be slightly over 14 volumes/100 cc. At surgery a large pulmonary vein was found to be draining both lobes of the lung It did not drain into the left auricle but toward the right auricle. Anastomosis was made between the side of the pulmonary vein and the end of the left auricular appendage. Postoperatively, she did well, was no longer cyanotic and exercise tolerance greatly increased. Six months later she had bronchial pneumonia of the left lung, from which she completely recovered.

CASE 2.—Woman, 25, had a four year history of severe exertional dyspnea. She was poorly nourished and developed, the heart was enlarged to the left, and a diastolic and systolic murmur could be heard over the second and third intercostal spaces to the left of the sternum. X rays revealed enlargement of the right ventricle and pulmonary artery, with prominent vascular markings in both lung fields. During cardiac catheterization the catheter passed directly from the superior vena cava into the right lung field. At surgery, complete transposition was found. A large vein draining the upper part of the right lung could be seen entering the superior vena cava. The pulmonary artery was very large. A large superior vein was found draining the upper part of the left lung and passing posteriorly into the right auricle. The end of the left auricular appendage was anastomosed to the side of the left superior venous trunk (Fig 58) She withstood the procedure well but died suddenly 10 hours postoperatively Autopsy was not performed

Treatment of Coronary Artery Insufficiency by Implantation of Internal Mammary Artery into Left Ventricular Myocardium. Arthur Vineberg[6] (McGill Univ) has experimentally proved that the internal mammary artery can, after implantation, carry the circulation of the left ventricle When the internal mammary artery is inserted in the ventricular myocardium, it forms new arterial branches which anastomose with the left coronary circulation. When this occurs, the heart lives by infarction following occlusion of the anterior descending branch of the left coronary artery Animals which survive ligation of the anterior descending branch of the left coronary artery either die or develop infarction when the implanted internal mammary artery is occluded.

Anastomosis is most frequent when a short segment of artery is freed from the chest wall, when the internal mammary artery is placed in the inner two thirds of the myo-

(6) J Thoracic Surg 23 42 44 January 1952

cardium and the sixth intercostal is left open when buried within the myocardium. Anastomoses have occurred in 50-75% of animals depending on implantation technic. These anastomoses have been shown by serial sections, special muscle and elastic stain studies and by casts to be formed of true arterial branches of the implanted internal mammary artery. Exercise tolerance of dogs has been increased conspicuously by internal mammary transplants after slow occlusion of coronary arteries with cellophane.

In severe coronary artery sclerosis, vessels within the heart muscle are generally free from arterial disease. Thus an internal mammary artery inserted between ventricular muscle fibers is in an area where arteries are comparatively healthy. In this way, fresh blood can be brought to the network of nonsclerosed arteries beyond points of coronary artery obstructions, ordinarily confined to the first 3-4 cm. of the coronary arteries. A history of a left coronary artery thrombosis with recovery does not contraindicate internal mammary implantation. The new living artery can be placed in healthy muscle at the edge of the healed infarct and, if necessary, into the intraventricular septum itself.

The operation has been performed four times in man. The internal mammary artery was pulled into position by blunt dissection between the heart muscle fibers. Heart muscle fibers are little damaged and practically no reaction occurs around the implanted artery. Branches from the implant reach the deep coronary arteriolar plexus. Three patients survived the operation. One died 62 hours after surgery following severe substernal pain. The internal mammary artery was patent at autopsy. Acute coronary occlusion was due to low blood pressure at surgery. One of the patients returned to work after five months; the others were improved. There is no evidence of harm to the existing coronary circulation from the procedure. Interpretation of postoperative electrocardiograms is difficult because implantation of a pulsating artery into the anterior wall of the left myocardium creates disturbances.

Treatment of Certain Aortic Coarctations by Homologous Grafts. Robert E. Gross[7] (Harvard Med. School) reports on 19 patients with coarctation of aorta who could not be

(7) Ann. Surg. 134: 753-768, October, 1951.

treated by excision and primary anastomosis Instead, the abnormal portion of aorta was removed and an arterial homograft inserted In most patients with coarctation the aorta can be reconstructed, but four situations require graft. (1) If the narrowed segment is several centimeters long, it cannot be completely excised with any hope of approximating the remaining ends (2) If the constriction is short but the aorta above and below is rigid and inelastic it may be difficult or impossible to bridge even a short gap by primary anastomosis (3) Any aneurysm of the aorta or intercostal arteries, must always be removed, as threat of rupture is probably a greater hazard than coarctation itself. (4) Occasionally, surgical injury to part of the aorta or its major branches might require sacrifice of a long segment of aorta Experiments *indicate that the inserted artery* may not last indefinitely, but instead forms a scaffolding or mold along which the host builds a new intima, adventitia and possibly a rudimentary media

Graft has been found necessary in one of every six or seven coarctations. Men, with their greater aortic rigidity and incidence of aneurysm, have needed grafts more often.

Sixteen patients were treated with fresh autopsy grafts *preserved* under *sterile* conditions in modified Tyrode's solution containing 10% human serum and 1% glucose, buffered to maintain pH near normal physiologic level. These had been stored from a few days to five weeks at 2-4 C For three patients no fresh grafts were available and vessels frozen in CO_2 snow and stored in a CO_2 refrigerator at —60 C for 2-72 days were used. After freezing in CO_2 they were sterilized by x rays. Fresh fluid stored grafts give somewhat superior longer lived results than frozen grafts.

A graft should be as large or *slightly larger* than the aorta because it tends to shrink. It should be handled delicately The upper anastomosis should be done first, so that excess graft can be trimmed when the lower part is sutured The *anastomoses should be made with interrupted mattress* stitches of 5-0 Deknatel silk (Figs. 59 and 60) There should be no tension on the suture lines The graft is then covered with parietal pleura Anticoagulants are not used postoperatively

Among 19 patients, 2 died, both on the fourth day of

renal failure and uremia certainly unrelated to grafting In the 17 survivors observed for a few months to three years, no ruptures or aneurysms have developed One had x ray evidence of calcification in the graft but clinical findings indicate an excellent aortic pathway There have been no symptoms or signs suggesting embolism from the graft From the viewpoint of therapy for pre-existing hyper

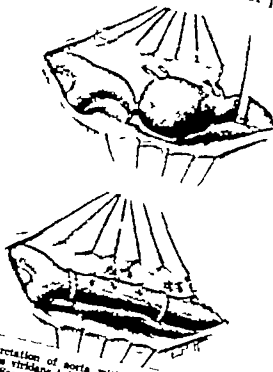


Fig. 59 (top).—Coarctation of aorta with thin-walled aneurysm below it (there had been a Streptococcus viridans infection) in man, 34

Fig 60 (bottom).—Same case; narrowed and dilated portions removed and replaced by graft.

(Courtesy of Gross, R. E. Ann. Surg. 134:753-768 October 1951.)

tension the over all picture has been excellent. Results can be classified as unsatisfactory in 1, fair in 1, satisfactory in 1 and excellent in 14 In the excellent group arm pressures have been restored to normal. Aortic grafts in man apparently tend to shrink slightly, as postoperative leg pressures greatly exceed the preoperative but seldom rise above arm pressures found with a full-sized pathway established by excision of a coarctation and primary anastomosis of the remaining ends.

[It is gratifying that this brilliant conception of using arterial homografts actually works.—Ed.]

Coarctation of Lower Thoracic and Abdominal Aorta Immediately Proximal to Celiac Axis Frank Glenn, Edward B C Keefer, David S Speer and Charles T Dotter[8] (New York Hosp) anastomosed the splenic artery and the proximal thoracic aorta in a patient, 19, with coarctation of the distal thoracic and proximal abdominal aorta partially involving the celiac axis, a berry aneurysm of the right renal artery, Recklinghausen's disease, congenital absence of vagina and uterine hypoplasia. She had been hypertensive for many years, with decreased arterial pulsation in both legs, blood pressure was 220/175 before sympathectomy in

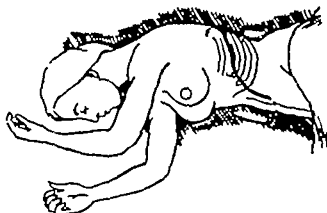


Fig. 61 —Operative incision ninth rib resected. (Courtesy of Glenn, F., et al: Surg., Gynec. & Obst. 94 561 569 May 1952.)

1948, 235/120 before anastomosis in 1950 and 140/88 twelve months later

Technic.—After a left thoracoabdominal incision (Fig 61), the left diaphragm was incised from costal attachment to aortal aperture. The spleen was excised and the splenic artery prepared for anastomosis with the thoracic aorta (Fig. 62) The aortic constriction was 10 12 cm. long and 0.8 cm. wide. The unvisualized distal portion could be felt entering the region of the celiac axis and its regional viscera. The proximal aorta was dissected free without division of the intercostal muscles. A Potts clamp was placed around the aorta and an end-to-side anastomosis performed (Fig 63) After this, the splenic artery distended normally and a good thrill was palpable The diaphragm was then repaired.

Postoperatively the patient improved clinically and an aortogram with catheter inserted in the left brachial artery showed blood flowing out the aortosplenic anastomosis in

(8) Surg., Gynec. & Obst. 94 561-569 May 1952.

the chest and returning through the splenoceliac junction, since it filled from above downward

Diagnosis and Treatment of Superior Vena Cava Obstruction. Karl P Klassen Neil C Andrews and George M. Curtis[9] (Ohio State College) state that gradual obstruction of the superior vena cava produces a syndrome characterized by venous distention and edema of the head, neck and upper extremities The commonest causes are primary endothoracic malignant growths, syphilitic aneurysms, mediastinitis and localized phlebitis with thrombus formation. Patency of the azygos vein major tributary of the superior vena cava must be considered in the problem of superior vena cava obstruction and establishment of collateral circulation. Occlusion may occur above the azygos vein with patency of this vessel and the proximal vena cava which results in venous return from the upper portion of the body passing by tributaries from the subclavian vein to the azygos-hemiazygos system and thence to the unobstructed portion of the superior vena cava and from there to the right auricle

Occlusion may occur at the junction of the azygos vein with the vena cava which effectively prevents all return of blood by way of the superior vena cava the azygos hemiazygos system forms an important channel with reversal of its normal flow The obstruction may occur proximal to the entrance of the azygos vein, which effectively blocks venous return to the auricle and blood returning from the upper part of the body is shunted from the superior vena cava directly into the azygos-hemiazygos system to the inferior vena cava. Although the azygos hemiazygos system is the major collateral pathway for the flow of blood from the superior vena cava to the inferior vena cava in this syndrome other pathways may develop (Fig 64)

Bronchogenic carcinoma arising in the right upper lobe may directly involve the superior vena cava Carcinoma in other parts of the lung may metastasize to the peritracheal lymph nodes and involve the vein. Tuberculosis and lymphomas may produce compression scarification or thrombosis of the vein.

Venous pressure determinations of both upper and lower

(9) A.M.A. Arch. Surg 63 311 325 September 1951

extremities substantiate the diagnosis, and venograms with simultaneous injection of 35 cc of 70 per cent diodrast* into the antecubital veins of both arms not only demon

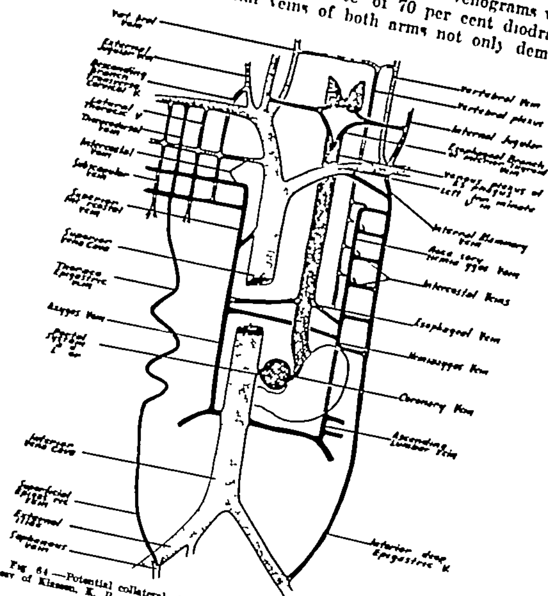


Fig 64 —Potential collateral circulation in superior vena cava obstruction. (Courtesy of Klassen, K. P., et al A.M.A. Arch. Surg 63:311-325 September 1951)

strate the location and degree of obstruction but also show collateral circulation.

In 4 of 12 patients, superior vena cava obstruction was produced by direct extension of bronchogenic carcinoma from the right upper lobe to the adjacent mediastinum In

two patients, surgery was impossible Exploratory thoracotomy was done in two patients, but at surgery it was evident that massive invasion of the mediastinum had precluded isolation of the superior vena cava for the purpose of decompression or any shunting procedure In one patient with inoperable neuroblastoma and one with inoperable carcinoma of the thymus, conspicuous reduction in venous pressure was noted after x ray therapy A patient with pulmonary teratoma near the superior vena cava had no symptoms of obstruction before surgery, but surgery probably saved her from the obstruction. In one patient with aneurysms of the ascending aorta and the innominate artery with compression of the superior vena cava, surgery was impossible One patient had a bandlike constriction of pericardium about the superior vena cava, after section of this band, symptoms were completely relieved, and venous pressure was decreased in the upper extremities. In one patient, thrombosis of the superior vena cava was diagnosed one month after severe trauma to the face and right shoulder At surgery the vein was thrombosed and the clot was not removable Mediastinal decompression produced no clinical improvement. In a patient with complete obstruction of the superior vena cava, x rays revealed a calcified peritracheal lymph node in the region of the vein. At thoracotomy the lymph node was medial to the azygos vein and near the vena cava. There was much mediastinitis Removal of the lymph node revealed destruction of the proximal portion of the azygos vein. A vein graft was placed between the azygos vein and the intrapericardial portion of the superior vena cava. Symptoms were relieved, and venograms six months later demonstrated the patency of the shunt and indicated the return of blood from the upper extremities to the right auricle by this newly formed channel.

Diseases of Superior Vena Caval System with Special Consideration of Pathology and Diagnosis J Ross Veal and Nicholas J Cotsonas, Jr [1] (Georgetown Univ) studied 137 cases. In obstructive diseases of the superior vena cava or any of its main tributaries, the superficial veins dilate quickly and a distinctive pattern forms one of the important signs in the diagnosis and localization of the site of obstruc

(1) Surgery 31 1 12 January 1952.

tion. The four cardinal signs of acute obstruction of a major vein are venous engorgement, edema cyanosis and pain in that portion which is drained by the occluded vein Measurement of an elevated venous pressure in the arms and normal venous pressure in the femoral veins establishes the diagnosis of obstruction of the superior vena cava and/or both innominate veins. Demonstration of a high venous pressure in one arm with normal venous pressure in the other extremities confirms the diagnosis of obstruction of the axillary and subclavian veins and/or the innominate vein on that side only Distention of the internal jugular veins and/or hypertension of these veins distinguishes innominate obstruction from occlusion of the axillary and subclavian veins The exercise test of the involved limb will give additional information in these obstructions for the venous pressure rises after exercise if the vein is obstructed In the normal patient or the patient with congestive heart failure venous pressure falls in response to exercise of the limb Phlebography is useful in demonstrating the point of venous obstruction and extent of collateral circulation and may be important in differential diagnosis of the cause Malignant neoplasms usually are shown to produce complete obstruction and dilatation of the superior vena cava in situ, whereas aneurysms of the arch and ascending aorta cause obstruction of the superior vena cava by displacement and compression In this series the various segments of the system were involved in the following order of frequency axillary and subclavian veins (58 cases) superior vena cava (50), brachial veins (14) innominate veins (11) and jugular veins (4) Causes of thrombosis were malignant neoplasms, local infections, compression from aneurysms, thrombosis resulting from venous stasis in congestive heart failure and some cases were associated with effort (trauma)

Only the patients with stasis venous thrombosis and septic thrombophlebitis had pulmonary embolism Penicillin was effective in septic thrombophlebitis and pulmonary embolism. Fourteen of the 18 cases of septic thrombophlebitis were in heroin addicts who administered the drug into an arm vein without sterile precautions. In seven of these the appropriate vein was ligated proximal to the septic thrombus.

Penetrating Wounds of Heart Report of 81 Cases Aubré De L Maynard, John W V Cordice, Jr, and Emil A. Naclerio[2] (Harlem Hosp, New York City) prefer pericardiotomy and primary cardiorrhaphy to conservative management by aspiration Of this series, 21 patients died before surgery of 61 operated on, 35 survived Survival depends on development of acute pericardial tamponade relief before the nocuous effects of tamponade cause death and prevention of recurrence Acute pericardial tamponade limits hemorrhage prevents voluminous blood loss and saves life in early phases of injury If prolonged, however, intrapericardial pressure prevents filling the heart and death ensues from cardiac compression A tamponade may be rapidly fatal or may be prolonged 10 hours or more without death Clotting in the pericardial sac may prevent further blood loss or constant or intermittent blood ejection from the pericardial wound may reduce pressure Sometimes the tamponade stabilizes and recovery without surgery and later constrictive pericarditis may result. Aspiration may occasionally be as effective as definite therapy

Clinically common to all heart wounds is shock. All who died before surgery were moribund or in deep shock when first seen. Of those operated on, 98% with myocardial wounds were in shock. All wounds over and around the cardiac area should be suspected Tamponade produces distant, muffled or barely audible heart sounds. X rays show diminished or apparently immobile cardiac shadow Exploratory thoracotomy is done immediately if sufficient clinical data suggest heart injury

Of 61 patients operated on, 12 had pericardial wounds, 49 myocardial wounds and 52 tamponade Nearly always the pericardial sac was filled with clotted blood. Although unrelieved progressive acute tamponade is fatal, many patients survive for hours Of 20 patients who did not reach surgery 12 had no tamponade

The first presurgical step is prompt management of shock by rapid intravenous infusion of physiologic saline plasma or both to increase venous pressure and counteract rise in arterial pressure due to tamponade Oxygen is given immediately Next, sucking chest wounds are temporarily closed,

(2) *Surg., Gynec. & Obst. 94 605–618 May 1952*

air is aspirated from the chest and bleeding of all wounds is arrested Best exposure for the heart is by left trans pleural thoracotomy

TECHNIC.—A left intercostochondral incision is used, thoracotomy is done through the 4th or 5th intercostal spaces (Fig 65) The 3d, 4th and 5th cartilages are sectioned near the sternal line and the pericardium is opened from its base on the diaphragm to its upper narrower part around the great vessels With tension released by evacuation of clots and fluid blood, bleeding may be brisk. The hand is plunged into the pericardium and digital pressure applied on

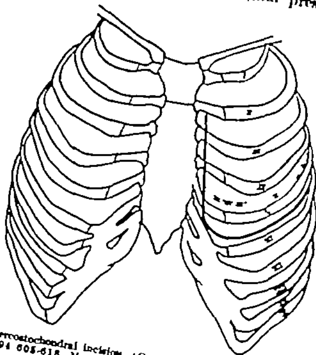


Fig 65 —Intercostochondral incision. (Courtesy of Maynard, A. DeL. et al : Surg. Gynec. & Obst 94 605-618 May 195)

either side or above the wound, but never in the wound itself (Fig 66) Digital compression is not recommended for an auricular wound. A rubber-shod clamp or Allis clamps should be used. In ventricular suture, a fairly large, half-circle nontraumatic needle with 00 or 000 silk is used with sutures passing down to but not through the endocardium. Fine petrolatum impregnated silk in interrupted sutures is preferred. A reinforcing layer of sutures should be placed over the primary closure. The pericardium should always be left widely open to drain into the left pleural cavity Chest and lung wounds are then treated.

Postoperative complications include pleural collections of fluid which can be aspirated pericardial collections of blood and fluid which can also be aspirated hemorrhage

from the cardiac wound, respiratory obstruction, tension pneumothorax sepsis, infection of stab wounds, and many extrathoracic complications Early postoperative deaths were

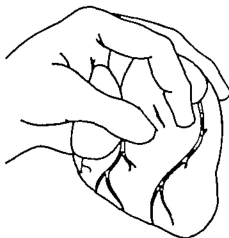


Fig 66—Digital occlusion and fixation of wounds for suture (Courtesy of Maynard, A. DeL. et al Surg., Gynec. & Obst. 94:605-618 May 1952.)

due to uncontrollable hemorrhage, hypoxemia, anoxemia, anesthesia, shock and technical surgical failures.

Aspiration alone is not good definitive therapy unless surgical facilities are inadequate for pericardiotomy and cardiorrhaphy

Foreign Bodies in Heart Indications for and Technic of Removal with Temporary Interruption of Cardiac Flow Henry Swan James H. Forsee and Edwin M Goyette[3] (Denver) state that removal of foreign bodies in the heart, which *either enter it directly or are embolic* by way of distal vessel, is indicated in (1) patients with evidence of persistent or recurrent sepsis as manifested by fever, leukocytosis, positive blood cultures, septic or bland emboli, recurrent bouts of pericarditis or evidence of progressive myocardial damage or dysfunction, (2) patients, with or without symptoms, in whom the foreign body clearly lies free in a heart chamber or impinges on a valve leaflet or myocardium during cardiac activity, and (3) patients with intractable cardiac neurosis related to foreign body Contraindications to elective removal include (1) foreign body under 3 mm. in diameter (2) asymptomatic patients with

(3) Ann. Surg 135:314-323 March 1952.

foreign body definitely lying entirely within the myocardium, and (3) asymptomatic patients without definite indications for intervention

Foreign bodies behave according to location Those free in a chamber tend to embolize, those within the myocardium, if uninfected, soon become enclosed in a fibrous capsule and do not tend to migrate or injure adjacent myocardium, those impinging on myocardium or valve leaflet cause erosion and favor bacterial invasion and myocardial destruction

Under current surgical conditions, with advances in anesthesia transfusion, antibiotics and technic, the deliberate removal of intracardiac foreign bodies presents slight immediate mortality risk

Angiocardiography with patient in left anterior oblique position is the best means of identifying the anatomic location of radiopaque foreign bodies

Wide incision from fourth interspace from anterior axillary line on the right to anterior axillary line on the left with sternum divided exposes the entire surface of the pericardium and gives access to all chambers and surfaces of the heart Temporary interruption of blood flow to the heart by compression of the venae cavae for a minute or two allows intracardiac manipulations in a dry field and facilitates removal of foreign body

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PERIPHERAL ARTERIES

Surgical Therapy of Acute and Chronic Arterial Occlusion is determined by pathogenesis of the arterial block and by the setting of the episode Jere W Lord, Jr.,[4] (New York Univ) indicates that sudden arterial block may be (1) embolic, (2) thrombotic (3) traumatic or (4) spasmodic in origin. Embolic arterial occlusion is seen in patients with mitral stenosis and chronic auricular fibrillation or in those with myocardial infarction and concomitant mural thrombus. The thrombotic episode usually occurs in persons with advanced arteriosclerosis

(4) Bull. New York Acad. Med. 28:258-274 April, 1952.

Arterial occlusion may be treated operatively or nonoperatively, depending on diagnosis and other related factors. Embolic cases should be operated on if seen within 10 hours of onset, if the obstruction is in the aorta, iliac or femoral

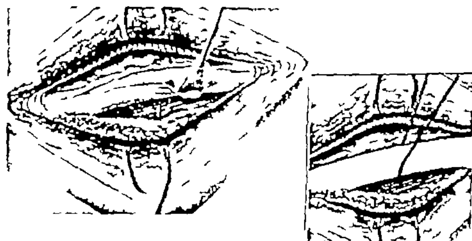


Fig. 67 (left).—Reflection of periosteum from clavicle; subclavius muscle, *F*.
Fig. 68 (right).—Section of clavicle with Gigli saw.
(Courtesy of Lord, J. W., Jr.: Bull. New York Acad. Med. 28:259-274, April, 1952.)

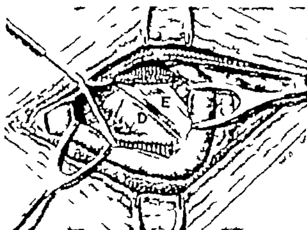


Fig. 69.—Exposure of subclavian artery, *D*, and brachial plexus, *E*. (Courtesy of Lord, J. W., Jr.: Bull. New York Acad. Med. 28:259-274, April, 1952.)

artery, and if the patient's general condition and age permit the procedure. Ideal management of acute thrombotic occlusion of a main artery is still conservative or nonoperative. Acute arterial occlusion due to trauma should be dealt with immediately. Prompt repair by direct suture, by autogenous

vein graft or by homologous arterial graft is ideal Spasmodic arterial occlusion, most common in massive venous thrombosis of the lower extremity, is best handled by Veal's method of vigorous passive and active exercise of the leg with marked elevation as soon after onset as possible Arterial spasm is relieved as soon as the venous block has cleared Lord has found attempts to revascularize the leg by producing a three limbed arteriovenous fistula unsuccessful. Similarly, scraping the thrombosed artery, leaving a shell of media and adventitia replacing a short segment of thrombosed artery by autogenous vein graft, and arteriec



Fig 70—No deformity of the shoulder girdle results and patient has full arm function after surgery (Courtesy of Lord, J W., Jr Bull. New York Acad. Med. 28 269-274 April, 195-.)

tomy are not thought worth while Sympathectomy is indicated for selected patients after thorough study

For patients with temporary and sometimes permanent occlusion of the subclavian or axillary artery due to one or more of the shoulder girdle syndromes operative procedure consists of total subperiosteal resection of the clavicle, followed by removal of the periosteum, division of the scalenus anticus muscle and mobilization of the subclavian artery (Figs. 67 69) Results in eight patients with 12 involved upper extremities have been uniformly excellent (Fig 70)

Definitive Treatment of Injuries to Major Blood Vessels Incurred in Korean War Everett H Dickinson, Thomas E. Ashley and Frank Gerbode[6] (Oakland, Calif) state that although incidence of vascular injuries in civilian life is low such injuries are not uncommon during a war There

(6) West. J Surg 49-625-624, December 1951

are differences of opinion as to the proper treatment for arteriovenous fistula and arterial aneurysm Some surgeons believe that quadruple ligation and excision of arteriovenous fistula, and ligation and excision of arterial aneurysms, are the safest and most effective methods if collateral circulation is present Some advocate restoration of circulation through the damaged blood vessel. The following objections have been raised to reparative procedures recurrence of the aneurysm or fistula, overlooking of additional openings of

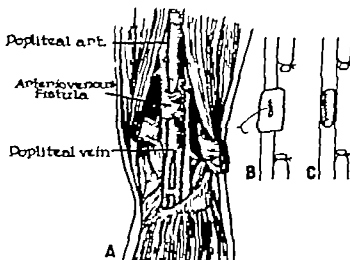


Fig. 71 —*A* right popliteal arteriovenous fistula *B*, transvenous closure; *C*, imbrication of vein over repair (Courtesy of Dickinson E. H., et al West. J Surg. 49 625-634 December 1951.)

a weak point in the arterial wall, and technical difficulties involved *The authors believe that the definitive treatment* should be directed toward maintaining the continuity of major arteries by such methods as lateral suture of the fistula, transvenous repair or vein grafting

Nineteen patients with disruption of major vessels were treated. Of these injuries, 13 were arteriovenous fistulas nine patients had associated aneurysmal dilatation. There were seven cases of arterial false aneurysm. One patient had two separate wounds, which accounts for the 20 lesions. Ten patients had associated injury to nerves in 8, such injury was associated with lesions in the arms and in 2 with arterial lesions in the legs

In eight patients with arteriovenous fistula, reparative

procedures restored circulatory continuity. Vein grafts were used to accomplish the repair in three, lateral suture was used in three, and transvenous closure was done in one (Fig 71). Quadruple ligation was necessary in four arteriovenous fistulas and ligation and excision in seven arterial aneurysms. Spontaneous closure of a small arteriovenous aneurysm was observed in one patient. In three patients with lesions in critical vessels, preoperative lumbar sympathectomy was done. Postoperatively, three dorsal sympathectomies were performed: two for circulatory insufficiency manifested by sensitivity to cold and one for postoperative pain. Viable extremities were obtained in all cases and there were no operative deaths.

Present Status of Surgery of Terminal Portion of Aorta is discussed by Jean Patel and Jean Natali[6] (Paris). The subperitoneal approach (Fig 72) is simple and sure: it al

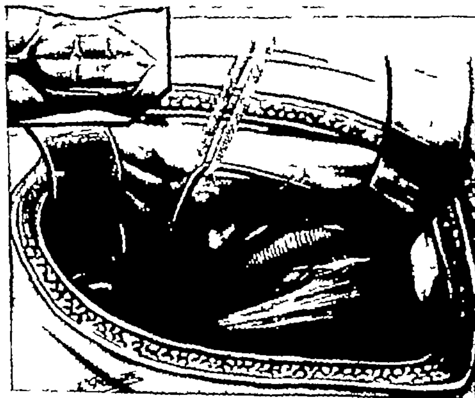


Fig. 72.—Subperitoneal approach. (Courtesy of Patel, J., and Natali, J.: J. chir. 67:599-620, Aug.-Sept., 1951.)

(6) J. chir. 67:599-620, Aug.-Sept., 1951.

lows good exposure without using the *Trendelenburg* position and is feasible under *local anesthesia*. However, it does not expose the contralateral iliac artery sufficiently or avoid collateral circulation through muscles and skin and it makes

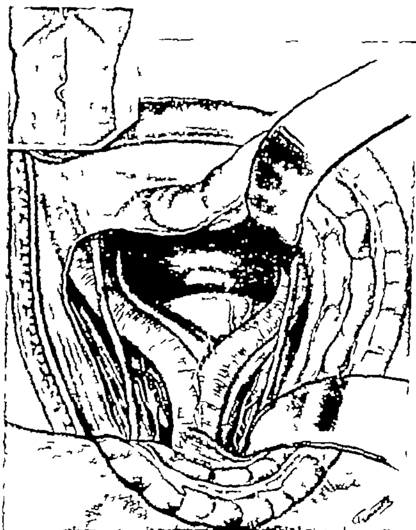


Fig. 73 —Excellent exposure obtained by freeing and mobilizing the colon and mesocolon. (Courtesy of Patel, J., and Natali, J J chir. 67 599-620 Aug-Sept., 1951)

bilateral lumbar sympathectomy difficult. The transperitoneal approach obviates these difficulties but the best exposure is by freeing and mobilizing the colon and mesocolon (Fig 73)

Symptoms of obliterative arteritis usually develop insidiously They consist of pain and severe fatigue in walking

or even on standing, painful sensations of cold in the lower limbs, cyanosis or extreme pallor of skin and, in males, impotence. Physical examination reveals muscular atrophy and no pulsation, but there are no trophic skin changes. Diagnosis is best confirmed by aortography. Without intervention, the course is initially slow and prolonged (5-10 years), once it develops, gangrene progresses fast and amputation at that time is useless. High lumbar sympathectomy, arteriectomy and a combination of the two have all

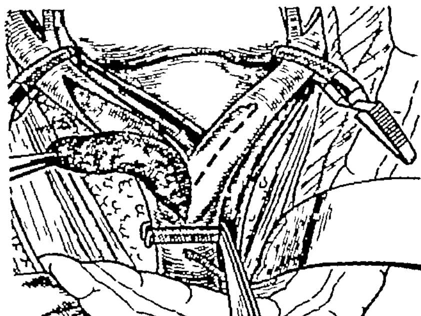
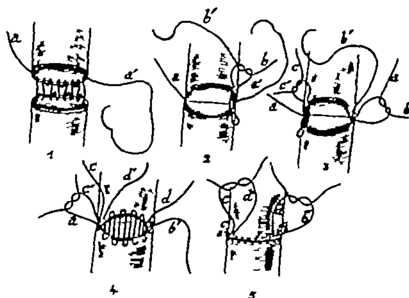


Fig. 74.—Endarteriectomy of the bifurcation and common iliac arteries. (Courtesy of Patel, J., and Natali, J. J. chir 67:590-630 Aug Sept., 1951.)

been tried. The combined procedure, preferably including a graft, has yielded much better results. In two series (15 patients in each) collected from the literature, the combined procedure resulted in an equal number of postoperative deaths, poor and good results. With the introduction of heparin, a method of endarteriectomy, which consists of excising the adventitia, incising the arteries longitudinally, removing the clot together with the endarterial "sequestrum" and closing the arteries with everting sutures (Fig 74) has also been used. Two series totaling 32 operations, have been reported with good results in more than half, but some authors remain skeptical. The use of homografts



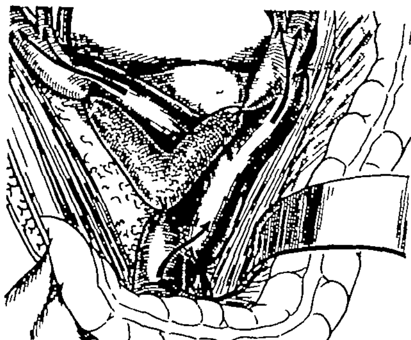


Fig. 75 (top) —Everting sutures used with aortic grafts.
Fig 76 (bottom) —Proposed method of shunting blood through a segment of adjoining [illegible]
(Courtesy of Patel, J and Natali, J J chir 67:599-630 Aug.-Sept., 1951)

with everted sutures (Fig 75) while successful in animals, has been reported only once in aortic bifurcation in man. The results were good though only one side remained patent. Another method, so far used only in animals shunts the blood

across the clot through a segment of the adjoining vein (Fig 76)

Emboli at the bifurcation occur in 4 5-8 7% of all instances of arterial emboli Typically they occur in cardiac patients especially if decompensated Onset is violent or may be heralded by prodromal symptoms caused by generalized vasomotor response Symptoms include severe periumbilical pain spreading to the legs pallor coldness and anesthesia of the legs and absence of femoral pulses The condition is rapidly fatal because of its effect on the heart Immediate surgical intervention is necessary Embolectomy most often used, is best performed by incision above or beside the clot, rather than through the femorals The intima is closely inspected It is rarely intact six hours after embolization, in which case arteriectomy followed by a graft if possible is performed Some surgeons proceed directly to resection if any time has elapsed since embolization In one collected series of 50 operations, results were satisfactory in 22

[Unfortunately probably many unsuccessful cases have not been reported. —Ed.]

Operative Treatment of Peripheral Aneurysms James J Clear and Louis G Herrmann[7] (Univ of Cincinnati) discuss operative procedures which have reduced incidence of arterial aneurysms Modern technics allow for early repair of the injured major artery by resection of the traumatized segment with an end to-end anastomosis or interpolation of a segment of vein to restore the continuity of the main arterial channel. If an aneurysm appears after injury to a major peripheral artery definitive treatment is delayed for three to six months to permit spontaneous development of adequate collateral arterial circulation Maximal vasodilatation is most effectively attained by surgical sympathetic ganglionectomy before or immediately after interruption of large arteries

Many technics are used to treat aneurysms The proximal artery may be ligated in three of four such patients the aneurysms were cured. Ligation of the distal artery is not recommended. Both the distal and proximal artery may be ligated in one such instance the aneurysm was cured An other course is aneurysmectomy ligating incoming and out-

(7) A.M.A. Arch. Surg. 83 452-457 October 1961

going major arteries, but this interferes with collateral arterial pathways.

Endo-aneurysmorrhaphy can be done in three ways (Fig. 77) All arterial openings may be obliterated by sutures from within the sac the endothelium may be reconstructed

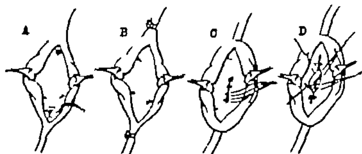


Fig 77—Various intrasaccular methods of treating aneurysms of the popliteal artery (Courtesy of Clear J J., and Herrmann, L. G.: A.M.A. Arch. Surg. 63:452 457 October 1951)

in the sac, or restorative endo-aneurysmorrhaphy may be accompanied by concomitant vein ligation and lumbar sympathetic ganglionectomy

Many methods are known of restoring continuity of large

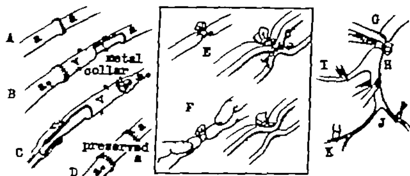


Fig. 78—Principles of surgery of large arteries. *A-D* methods of restoring continuity of large arteries; *E-F* methods of ligating large arteries; *G-K*, size of ligature material for various sized arteries. (Courtesy of Clear J J., and Herrmann, L. G. A.M.A. Arch. Surg. 63 452-457 October 1951.)

arteries by excising the aneurysmal sac and by end to-end arterial anastomosis (Fig 78) The method of choice is extrasaccular ligation of the proximal and distal arteries with suture of the collateral arteries from within the sac. The ligature material and method of application must be em

phasized Complete occlusion of a large artery depends on the rapidity of ingrowth of fibrous tissue into the ischemic segment included in the ligature If a large segment is included in a cotton tape about one half the width of the diameter of the vessel, the rate of necrosis will be slower and fibrous tissue will replace the ischemic segment more completely Any ligature that is too narrow will cut through the arterial wall, whereas absorbable ligatures tend to loosen before fibrous tissue replaces the segment The degree of damage to the arterial coats at the time of ligation is in direct proportion to the speed and force used in tying the knot.

Accidental Incision of Aneurysm of Left Common Carotid Artery Treatment by Thoracocervical Excision with Recovery is reported by Mark H Williams[8] (Binghamton, N Y) Man, 55 was hospitalized for biopsy of a nonexpansile tumor 3 cm. in diameter, observed for two months low in the left side of neck. (History of penetrating neck wound in World War I was elicited until after operation although a chest x ray taken 2½

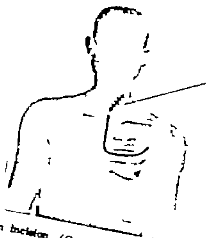


Fig. 79 —Outline of skin incision. (Courtesy of Williams, M H : Ann. Surg 135: 267 277 February 1952.)

years previously was later found to show aneurysm.) Under local anesthesia, incision was made by a surgical colleague along the anterior border of the lower third of the left sternocleidomastoid muscle which was retracted laterally to expose a firm, calcific mass lateral to the carotid artery Opening the mass, 8 cc. of putty like material was removed, leaving a yellow friable wall, incision of which resulted

(8) Ann. Surg. 135 267 277 February 1952

in furious hemorrhage (300 cc) arrested by packing and suture of the wound

After a brief delay for cross-matching blood, Williams made a thoracotomy incision under intratracheal ether oxygen in the third inter space at the anterior axillary line which was extended medially (Fig 79), entering the pleural space through the third interspace after dividing the internal mammary vessels, the third cartilage and the sternum (Fig 80) Rake retraction to the left exposed the left innominate vein and common carotid artery, which were elevated with

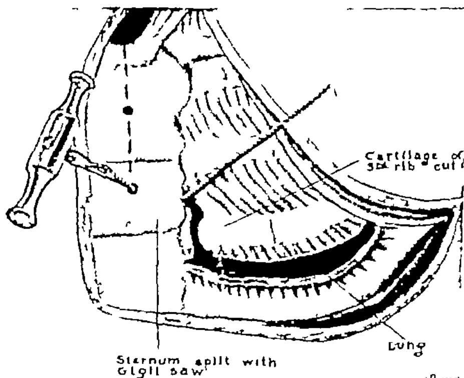


Fig. 80 —Section of third costal cartilage and preparation for division of sternum with Gigli saw (Courtesy of Williams, M. H. Ann. Surg. 135 267 277 February 1952.)

tapes. The first operative wound was then opened and joined to this incision. Elevating the tapes on the vessels, he removed the packing starting another severe hemorrhage (300 cc.) which required re-packing and a 1,000 cc. transfusion to elevate blood pressure to a satisfactory level. Further dissection isolated the jugular vein and common carotid artery which with the innominate and subclavian veins were elevated with tapes. When the packing was removed, hemostasis had been achieved and aneurysm of the left common carotid artery was diagnosed (Fig 81) Active bleeding took place when pressure was released from above (Henle-Coenen phenomenon) The artery was doubly ligated by cotton transfixion 2 cm.



Fig 81—Exposure obtained by completed thoracocervical incision illustrating pathology and point of division of vessels. Tapes used to control bleeding are not shown. (Courtesy of Williams, M. H.: Ann. Surg 135 267 277 February 1952.)

above and below the aneurrsm and divided. The jugular vein was similarly ligated and divided and the aneurysm and adherent vein separated from the vagus nerve Staggered drill holes were made in the bone flap, sternum and third cartilage to secure firm reapposi tion by wiring (Fig 82) Altogether 2,000 cc blood was transfused in this 5½ hour operation Postoperatively there were left lower lobe partial atelectasis, temporary (six months) paralysis of the left hemidiaphragm and attacks of faintness (for five weeks) attributed to cerebral anemia. The patient returned to work eight weeks after operation

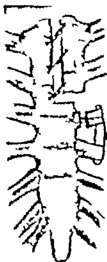


Fig 82—Bone flap and thoracotomy incision is approximated as illustrated. Drill holes should be slightly staggered and wire sutures tied as tightly as possible. With these precautions no grating will occur during cough and postoperative pain is less than after a conventional thoracotomy (Courtesy of Williams, M. H. Ann. Surg 135 267 277 February 1952)

In management of active bleeding a thoracocervical incision gives excellent exposure and permits rapid proximal control of hemorrhage as a "combined approach" Ac-

tive bleeding from the distal end of the common carotid artery at operation (Henle Coenen test) presents a favorable indication that ligation will be safe

[Too bad the first surgeon did not insert a needle into the mass for aspiration after exposing it He would then have realized he was dealing with an aneurysm and could have handled it deliberately instead of as an emergency—Ed.]

Regional Heparinization after Thromboendarterectomy in Treatment of Obliterative Arterial Disease Preliminary Report Based on 12 Cases is made by Norman E Freeman and Rutherford S Gilfillan[9] (Univ of California) Object of the therapy was to keep blood from clotting in the vessel operated on, and yet, at the same time, to allow blood to clot elsewhere In one patient the axillary and brachial arteries were involved, in two, the femoral popliteal artery in one, the external iliac and common femoral arteries in one, the superficial femoral and popliteal arteries, and in one, the common iliac artery

Thromboendarterectomy may greatly benefit patients with obliterative vascular disease The operation is possible because there is a line of cleavage between the thrombotic material and the viable arterial wall just within the internal elastic membrane After removal of the thrombus, intima and part of the media, sufficient viable arterial wall remains to permit closure with restoration of the lumen of the artery

TECHNIC—After adequate exposure of the involved artery, the main vessels above and below the zone of obstruction are temporarily occluded by clamps, which must be placed so as not to crush the vessel wall A longitudinal incision is made in the vessel wall beyond the limits of the thrombotic area and down into the occluding material. By blunt dissection the occluding mass, called a sequestrum by Arnulf, is easily removed At the origin of branches of the main artery the atheromatous thickening disappears, and at these points the lining is cut across with fine scissors. It is useful to divide the vessel lining obliquely at the proximal and distal ends of the atheromatous plaque in order to prevent too abrupt an ending of the thickened vessel wall. The lining of the artery at both ends is tacked down with three or four sutures of 5-0 Deknatel braided silk to prevent development of dissecting aneurysm. The denuded portion is then irrigated with heparin solution 50 mg in 250 cc. saline, and the vessel closed. A continuous over and-over stitch with 5-0 Deknatel braided silk is satisfactory

A segment of polyethylene tubing with an internal diameter of 0 011 cm. and an external one of 0 024 cm. is then inserted in the

(9) Surgery 31 116-131 January 1952

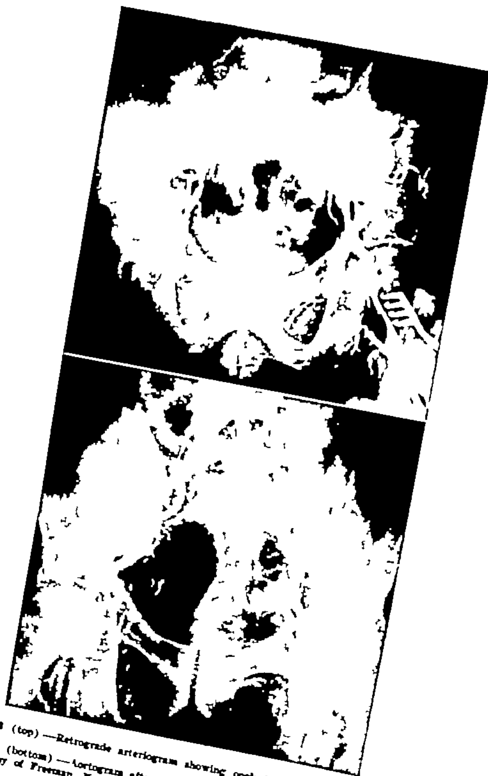


Fig. 83 (top).—Retrograde arteriogram showing occlusion of right external iliac artery.
Fig. 84 (bottom).—Aortogram after thromboendarterectomy of artery.
(Courtesy of Freeman, N. E., and Gilfillan, R. S.: Surgery 31:115-131, January 1952.)

proximal artery above the upper clamp and kept in place by a purse-string suture A 27 gauge needle is inserted in the proximal end of the tubing and connected to a syringe containing heparin solution, 20 mg /100 cc. saline Free flow of heparin into the artery and blood coming out when injection pressure is released are essential for the successful operation of regional heparinization. The polyethylene tubing is brought out through a separate opening made by an 18 gauge needle and heparin solution injected continuously

The clamps on the distal artery are released. Bleeding points are closed with figure-of-eight stitches of 5-0 Deknatel braided silk. As soon as possible the clamp on the proximal artery is gradually released to provide for rapid flow of blood through the previously occluded segment. All bleeding areas are stopped digitally or with silk sutures. During the immediate postoperative period after the wound is closed and the patient returned to bed, constant intra arterial injection of heparin solution, 10 mg /100 cc. saline, or 5% glucose in distilled water is used. Speed of injection is altered to keep the systemic clotting time close to 20 minutes, as determined by the Lee-White method. A constant injection pump may be used.

Intra arterial heparinization has been continued for one to eight days. It is advisable to check patency of the tubing at frequent intervals by discontinuing the injection temporarily to see if arterial blood comes back through Generalized anticoagulant therapy has been continued for three to six weeks to permit endothelization of the arterial segments.

Of the 12 patients, 2 died 1 of aspiration pneumonia and 1 of acute myocardial infarction. In four patients the artery became occluded again. In one of these mid thigh amputation was later necessary but in two the limb was saved It is believed that insertion of the tubing from below the occluded area was responsible for the failures. In one patient the tubing could not be passed into the artery satisfactorily and systemic anticoagulant therapy was used.

In six patients restoration of the lumen of the obstructed artery was clearly demonstrable The pre and postoperative arteriograms of a 62 year old man with acute arterial occlusion of the right iliac artery are shown in Figures 83 and 84. Hemorrhage was not a complicating factor in any patient.

[Seems to be a logical and useful suggestion —Ed.]

Arterial Homografts III. Use of Preserved Grafts in Treatment of Neoplastic Disease Involving Peripheral Arteries. Henry Swan and H. Mason Morfit[1] (Univ of Colorado) discuss three cases An artery bank is essential for

(1) A.M.A. Arch Surg 62 767 775 June, 1951

this type of work The graft is stored at 4 C in Ringer's solution, to which has been added human plasma (10% by volume) and small amounts of penicillin and streptomycin The homogenous artery selected should be taken from a person aged 10-35, who was free from transmissible disease,

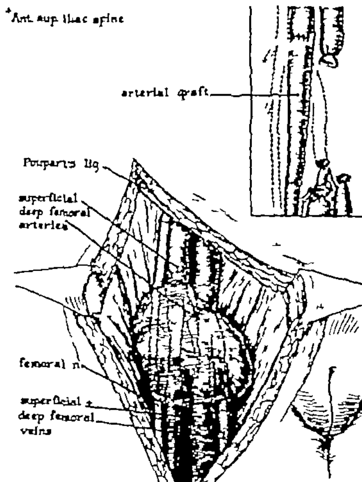


Fig. 85—Appearance t operation. Vascular reconstruction. (Courtesy of Swan H., and Moritt, H. M. A.M.A. Arch. Surg. 62 767 775 June 1951.)

and it should be removed within four hours of death and stored less than three months

CASE 1.—Man, 75, had a history of hypertension, auricular fibrillation and mild diabetes. He also had a firm, tender lump 7 cm. in diameter in the right upper thigh for 18 months Aspiration biopsy showed soft part sarcoma. Since stored artery graft was not available, block excision was done. It included 2 in. of the superficial femoral artery and its accompanying vein, since the artery ran

through the tumor The deep femoral vessels were not involved. The deep femoral vein, which contained sclerotic plaques, was used to bridge the arterial gap with suture technic. He did well despite moderate wound separation that required secondary skin grafting. The foot remained warm, though considerable edema of the extremity developed. Histologic diagnosis was neurogenic sarcoma. He



Fig 86.—Moderate swelling but good function of right leg six months after operation. (Courtesy of Swan, H., and Moritt, H. M. A.M.A. Arch. Surg 62 767 775 June 1951.)

was leading an active life 1½ years later with no evidence of recurrence.

Case 2.—Woman, 39, who had undergone three excisions of neurosarcoma from the right femoral triangle seven to two years previously, had recurrence. The tumor was about 3 × 4 cm., directly over and enclosing the femoral vessels, and movable beneath the skin. It was excised *en bloc* with the common femoral artery and vein and the femoral nerve from which it appeared to take origin (Fig. 85) The deep femoral vessels were ligated because the bifurcation was involved, and the arterial defect was bridged with an 8 cm.

and froze them rapidly in liquid nitrogen or slowly in a deep freeze After varying periods of storage, the blood vessels were used as arterial homografts in dogs, and the grafts were studied after observation periods of 27 to 165 days. There was a high incidence of thrombosis in both the slowly and the rapidly frozen carotid homografts. All of the rapidly frozen aortic homografts were patent except one, which was hemorrhagic Macroscopically, the inner surface of all specimens showed uniformly satisfactory healing at the anastomoses. Neither length of storage nor duration of postoperative period could be related to the incidence of thrombosis However, many of the rapidly frozen carotid grafts showing thrombosis came from vessels collected under conditions of uncertain sepsis Almost all the aortic grafts rapidly frozen by immersion in liquid nitrogen for five minutes showed small cracks in the intima.

Microscopic examination of grafts that have been in place for only a short time showed hyalinization of the media of the artery with absence of nuclei and disappearance of muscle The internal and external elastic laminae were preserved, however Older grafts showed normal intima and adventitia but loss of media

Tissue culture studies revealed that cells from quickly frozen vessels yield a fair growth of fibroblasts, whereas those from the slowly frozen vessels did not survive in the culture

Vessels 6 mm. in diameter and larger can provide arterial grafts which will remain patent by rapid freezing These vessels show normal physical characteristics, and there is no progressive change after three months. There is a higher *proportion of failures with vessels 3 mm. or smaller* The slow freezing method is functionally and histologically inferior to the rapid freezing procedure

The principles for preparing frozen arterial grafts include freezing by the steepest available gradient. If liquid nitrogen is used for the initial freezing a two phase method is necessary with interruption at 15 seconds. Solid carbon dioxide-ether mixture offers a good method of freezing without the need for interruption, but cell survival is less likely than with liquid nitrogen. Storage should be at the coldest practical level. Temperatures in a deep freeze are usually

between −15 and −20 C More effective, but less convenient, is a solid carbon dioxide freeze at −70 C

In a man 60 an occluded popliteal artery was restored with a quickly frozen arterial homograft, with excellent results five months after surgery

Experimental and Clinical Experiences with Use of Fascia Lata Applied as Graft about Major Arteries after Thromboendarterectomy and Aneurysmorrhaphy Edwin J Wylie, Edwin Kerr and Orland Davies[3] (Univ of California) show that restoration of patency of chronically occluded arteriosclerotic arteries and repair of aneurysms due to arteriosclerosis are possible by the use of fascia lata to support the arterial wall Fascia lata prevents poor closure of the arterial incision due to the poor structure of the remaining vessel wall and also aneurysmal dilatation which may appear in the weakened artery after operation

Experimental operations were done on dogs to produce a degree of trauma and weakening of the aorta similar to that produced in the arteries of human subjects after thromboendarterectomy Weakening and permeability of the arterial wall were observed in all When occluding clamps were released before the weakened aorta was wrapped in fascia, there were gross bleeding from the suture line and rapid dilatation of the weakened segment Fascia lata applied as a graft about the aorta gave adequate support to the weakened segments. Microscopic sections demonstrated that the operative defect in the intima of the traumatized aortas was covered by a layer of clotted blood soon after restoration of blood flow through the lumen Repair of the arterial walls was characterized by rapid appearance of connective tissue in all layers of the thrombus with diffuse formation of an endothelium like surface layer

Six patients with occlusion of major arteries were treated by thromboendarterectomy The length of the thrombosed segments varied from 7 to 22 cm There were no operative deaths Two patients died postoperatively of cerebrovascular thrombosis Amputation was eventually necessary on one patient because of chronic thrombosis in distal arteries too small to be amenable to surgery and in another because of the long interval between onset of acute thrombosis and operation

(3) *Surg., Gynec. & Obst.* 93:257-272, September 1951

In all cases arteries from which thrombosis had been removed remained patent Additional support to the weakened arterial segments was clearly necessary in three cases. The use of fascia lata lessened the tendency for postopera

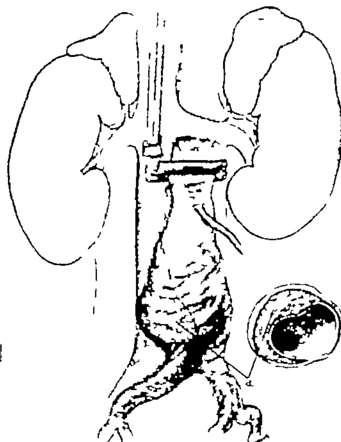


Fig 87 —Aneurysm of abdominal aorta. Layer of degenerated material in media (d) has partially occluded aorta and completely occluded right iliac artery Thinning of outer layer is seen in cross-section. (Courtesy of Wylie E. J., *et al.*: Surg., Gynec. & Obst. 93 257 272 September 1951.)

tive thrombosis by preventing the localized areas of dilatation.

Although the initial obstructive process was intramural in all cases, freshly clotted blood filled the lumen of the artery distal to the area of primary occlusion in two and proximal to it in another This ol- ion suggests that when acute thromb f an art ic artery occurs, early removal d uction nt

In one patient with an aneurysm of the abdominal aorta, use of fascia lata as an external supporting layer made performance of restorative aneurysmorrhaphy possible

Man, 62, had a fusiform aneurysm of the aorta beginning just distal to the renal arteries and reaching a maximal diameter of 8 cm at the bifurcation of the aorta (Fig 87) After the proximal aorta and distal iliac arteries were occluded with clamps a longitudinal incision was made into the aneurysm The interior of the aorta was partially filled with necrotic semisolid granular material occupying an intramural plane During mobilization of the aneurysm the lat

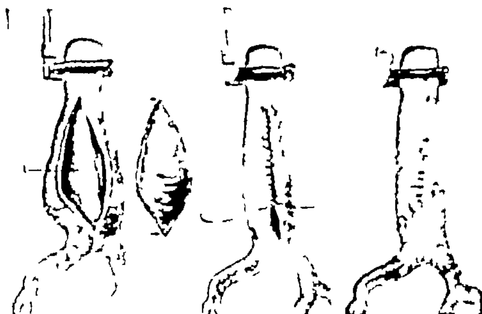


Fig 88 (left) —Excision of portion of anterior wall of sac and removal of detached intima and debris with thin strip of intima (I) remaining attached posteriorly

Fig 89 (center) —Closure of remaining wall with restoration of normal contour of aorta.

Fig. 90 (right) —Supporting layer of fascia lata sutured about patent aorta.

(Courtesy of Wylie E. J et al : Surg., Gynec & Obst 93:257-272 September 1951)

eral surface of the outer aortic wall was ruptured The detached intima was resected from the aorta and from the proximal 1 cm of the left iliac artery It was necessary to rongeur away several large, protruding calcareous plaques on the posterior wall to open the lumen adequately A segment of the anterior wall of the aneurysm was excised (Fig 88) Closure of the remaining wall restored the aorta to its normal diameter (Fig 89) To reinforce the suture line, the distal aorta was wrapped with a sheet of fascia lata taken from the left thigh (Fig 90) A pulsatile flow of blood appeared in the left iliac vessels as the arterial clamps were released. No bleeding was observed at the site of repair Aortography one month after operation showed normal contour of the abdominal aorta.

hospitalization his right arm became cold and pulseless and all the signs and symptoms of Volkmann's contracture developed although he had no known injury to this arm

Experience with these cases showed that Volkmann's contracture is not a separate entity but merely a stage between complete recovery of the limb and total gangrene

Collateral Resistance in Limbs with Arterial Obstruction Spontaneous Changes and Effects of Sympathectomy A C Dornhorst and E P Sharpey-Schafer[6] (St Thomas's Hosp Med School) measured blood pressure and blood flow in extremities distal to an arterial occlusion and interpreted results in terms of resistance offered by the collateral bypass Blood pressure was measured with an intra-arterial needle and a capacitance manometer and blood flow with an air filled venous occlusion plethysmograph

In normal subjects, local blood pressure was little affected by changes in distal flow When the main artery was occluded augmented peripheral resistance caused a rise of pressure and on release of occlusion reactive hyperemia caused a fall This would indicate that an unobstructed main artery acts as a supply of blood with a low internal resistance whereas the collaterals by passing an arterial occlusion present a substantial resistance

Spontaneous decrease in collateral resistance begins within a minute of acute arterial occlusion In one subject there was evidence that the resistance continued to fall for a few days. Sympathectomy was found to cause a considerable decrease in collateral resistance both in acute and chronic occlusion, but in 7 of 10 subjects the decrease was transient

Occlusive vascular disease often affects larger arteries, while small vessels of the periphery are normal The resting blood flow in affected limbs may be normal despite lowering of local arterial pressure presumably because local metabolic control causes peripheral arteriolar dilatation. The lowering of local arterial pressure that occurs when peripheral resistance is decreased probably accounts for the blanching of the foot and the decrease in oscillometric readings that often follow exercise of a leg with arterial disease

Sympathectomy did not achieve a sustained decrease in collateral resistance If in addition to a main vessel occlu

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(6) Clin. Sc. 10:371-381 August 1951

sion, disease of the skin vessels prevents their dilatation, the sharp fall in local arterial pressure which may follow sympathectomy must lead to further decrease in skin flow and may even precipitate gangrene

Paradoxical Results of Vasodilator Intervention for Arterial Thrombosis L. Masse and R. Tingaud[7] (Bordeaux) observed trophic changes and ulcerations, sometimes of a serious nature in the distal part of the affected limb after such surgery, although general circulation to the limb had improved They attribute this to the existence of two "territories" of ischemia, in the distal zone all vasodilatation capacity may have been lost. Sympathetic surgery not only affects arterial but also venous and capillary tone so that the proximal zone in such cases acts as a shunt and the supply to the distal part is decreased even more No criterion can predict with certainty this complication However in patients in whom pulsations cease at the root of the limb circulatory tests bring about almost no modification and arteriography reveals reduced circulation in the thigh and practically none in the leg vasodilator surgery should be undertaken only with great precautions. In young patients with thromboangitis in whom such a situation is found and who refuse thigh amputation such surgery might be performed after amputation of the distal portion of the leg

Raynaud's Phenomenon Review of Clinical Problem as seen in 227 patients is presented by R. P Jepson[8] (Univ of Manchester) In fingers which manifest Raynaud's phenomenon, the excessive contraction ("local fault") of the arterial wall in response to cold is such that the blood flow stops completely producing an aching "white finger When the finger is again exposed to warmth, the artery relaxes and the first trickle of blood into the small vessels rapidly becomes deoxygenated (blue cyanotic stage) Finally a reactive hyperemia ("pink burning" stage) sets in, probably because of local accumulation of metabolites during asphyxia of the tissues

Factors that produce Raynaud's phenomenon are (1) excessive response to local cooling the most important (2)

(7) Lyon chir 46 601-606 J ly 1951
(8) Ann Roy Coll. Surgeons England 9 35-51 July 1951

sympathetic vasoconstrictor impulses brought about by body cooling pain or emotion, (3) occlusion by an atherosclerotic thrombus in the subclavian or brachial arteries, and (4) arterial disease of the digital vessels themselves. There are therefore, two main divisions of patients with Raynaud's phenomenon (1) those with abnormal vasoconstriction of anatomically normal vessels and (2) those with normal vasoconstriction of abnormally occluded vessels.

Clinically, Raynaud's phenomenon may be further classified as primary or idiopathic and secondary. The idiopathic type is symmetrical bilateral response to cold more severe in the hands than in the feet commencing at the finger tips and moving proximally up to the metacarpophalangeal crease. The attack persists from minutes up to an hour. Quick warmth usually relaxes the vessels unless digital artery spasm is frequent or persistent when nutritional changes e g, small pulp ulcers, nail changes pulp atrophy and chronic paronychia arise in the affected fingers.

Secondary Raynaud's phenomenon may be due to obliterative vascular disease, acquired local fault or the syndrome of the middle-aged female. In patients with obliterative vascular disease attacks are of recent onset, asymmetrical and associated with chronic ischemia in the legs. Atherosclerosis of the digital arteries is common in the over 30 age group. Prognosis depends eventually on the site and extent of the thrombotic episodes at times gangrene produces loss of whole fingers. Acquired local fault may be associated with vibrating tool syndrome (work should be stopped as soon as symptoms are noticed), rheumatoid lesions (sympathectomy contraindicated during elevation of blood sedimentation rate) scleroderma or hypodermolithiasis. The middle-aged female syndrome is associated with normal or artificial menopause and is often benefited by small doses of estrogens.

Milder attacks are controlled by avoidance of cold and use of warm clothing and vasodilator drugs such as priscoline.* If insufficient improvement results from these measures, sympathectomy may be considered. Sympathectomy was done in 63 of the 227 patients. Cervicothoracic ganglionectomy removing the stellate and the second and third thoracic ganglions, was done by anterior supraclavicular

approach through a 2 in scar bilaterally In later instances the stellate ganglion was spared, thus avoiding a Horner's syndrome and annoying nasal obstruction caused by vasodilatation, the results were found to be as satisfactory Several patients complained of postoperative shoulder ache radiating to the scapula and arm worse at night, and lasting many months before eventually disappearing

This series shows considerable divergence in results from those of others (Fig 91) probably because operation was

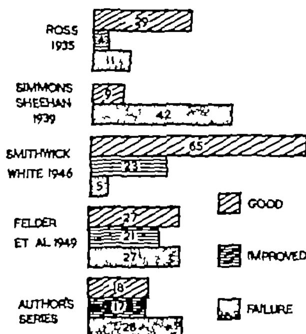


Fig 91 —Collected results in Raynaud's phenomenon. (Courtesy of Jepson, R. P Ann. Roy Coll. Surgeons England 9 35 51 July 1951)

done only in more severe cases and different criteria were used for improvement Best results are obtained in occlusive vascular disease with no local fault in the digital vessels and in instances of mild and nonprogressive disease Failures with sympathectomy occur in severe disease with marked local fault and in patients with progressive (such as rheumatoid and scleromatous) lesions. Although temporary improvement may follow sympathectomy late relapses are common following severe illness, probably because of compensatory activity of alternate sympathetic pathways. When local vascular sensitivity to cold predominates, denervation

than in similar ones of arteriosclerosis When infection is present in association with the ischemic lesion the degree of the inflammatory response will aid in assessing the collateral blood supply A good inflammatory response with redness, heat and swelling indicates a good collateral supply despite the level of main arterial occlusion and is of value in predicting successful local amputation.

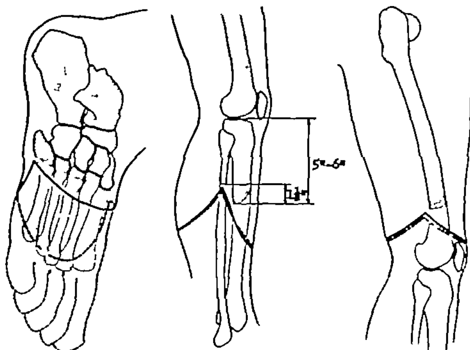


Fig. 92 (left) —Transmetatarsal amputation. Note that lateral four metatarsals are sectioned in straight line from level of first tarsometatarsal joint, leaving bases of these lateral four

Fig. 93 (center) —Classic site of election amputation, using equal flaps.

Fig. 94 (right) —Supracondylar amputation necessary in most cases of distal gangrene.

(Courtesy of Luke, J C. Canad. M. A. J 65 343-347 October 1951)

The investigation should include a history of the length of time ischemia has been present, a careful local examination, urine and blood examinations for diabetes, an electrocardiogram, chest x ray and general review of the cardiovascular system, skin temperature readings before and after blockage of the lumbar sympathetic chain, oscillometric readings and histamine flare tests

There are only three suitable sites for amputations, the transmetatarsal (Fig 92) site of election (Fig 93) and

supracondylar (Fig. 94). In all flaps should be equal in length and contain deep fascia. In below knee and supracondylar types the muscle should be divided at the level of bone section and the proximal periosteal stripping should not be more than a ½ in. from the cut level of the bone. Absolute atraumatic technic is essential in all such amputations, with removal of all tags of devitalized tissue produced by the operation.

SYMPATHECTOMY

Effects of Splanchnicectomy on Blood Pressure in Hypertension Controlled Study. To evaluate more accurately the effects of various types of sympathectomy on the blood pressure of patients with essential hypertension, S. W. Hoobler, J. T. Manning, W. G. Paine, S. G. McClellan, P. O. Helcher, Henry Renfert, Jr., M. M. Peet and F. A. Kahn[1] followed 338 splanchnicectomized and 79 control patients for 10-18 months. Patients over 55 were excluded from the study, as were those with evidence of nitrogen retention or whose hypertension was secondary to renal disease or complicated by a recent cerebrovascular accident, myocardial infarction or congestive heart failure. The operation consisted of one stage bilateral removal of the greater and lesser splanchnic nerves and sympathetic ganglions at the level of the twelfth thoracic vertebra and above. Usually the upper limit of removal was the eighth thoracic vertebra. Blood pressure in the right arm was determined after 30 minutes recumbency.

In only one control did reduction in the diastolic pressure exceed 20 mm. Hg. For various reasons blood pressure data could not be obtained for 44 of the patients operated on. Of the remainder, 98 (33 per cent) had diastolic pressure reductions exceeding 20 mm. Hg. Significant reductions occurred more often in patients with high initial blood pressures; patients with initial diastolic pressures below 110 mm. Hg did not often show them. The patients operated on had a median reduction of 16 mm. Hg. A fall of systolic

(1) Circulation 4:173-183, August 1951.

pressure exceeding 30 mm. Hg, which was outside the range of spontaneous variation in the control group, was observed in 95 patients (28 per cent)

When patients were compared on the basis of whether the result of surgery was good or poor, no factor of preoperative prognostic value was found Age distribution known duration of hypertensive disease and preoperative response to vasolability tests were almost identical in the two groups. In general, results were less likely to be good in patients with vascular complications of hypertension Patients with malignant hypertension did far worse than those with uncomplicated essential hypertension. It appeared that the pressure becomes reasonably stabilized after a year, and that it is then possible to estimate the frequency of good results

Bilateral extension of the denervation upward from the twelfth thoracic vertebra to the sixth or over gave a better postoperative result than did conventional ganglionectomy (eighth to twelfth thoracic) This is in agreement with a previous report. Magnitude of the response to cold pressor tests was not reduced by operation.

Splanchnicectomy is apparently effective because of removal of an important area of increased vascular resistance Return of blood pressure to hypertensive levels may occur by compensatory vasoconstriction in nondenervated areas, restoration of neural control of the splanchnic bed and recovery of intrinsic vascular tone The assumption that certain patients are benefited by sympathectomy simply because they have excessive neurogenic vasomotor tone is not warranted Although blood pressure reductions in this series were perhaps not as common as those which have been reported to follow other types of surgery the authors believe that this less radical operation has a real place in routine treatment of established hypertensive disease which does not respond to medical management.

Physiologic Principles Underlying Treatment of High Diastolic Hypertension by Thiocyanates and Sympathectomy were investigated by Loyal Davis, Joseph Tarkington and Robert K. Anderson[2] (Northwestern Univ) in an attempt to explain why patients previously resistant to thiocyanate

(2) Ann. Surg 133 867-872 June 1951

therapy become sensitive to the drug after sympathectomy Pressor substances cannot be formed without the participation of the liver and adrenal glands Therefore, periodic histologic studies were made of these organs in animals and man under varying experimental conditions

Rats were given injections of potassium thiocyanate Histologic sections of the adrenal cortex showed depletion of lipid content in all layers slightly more striking in the zona glomerulosa and proportional to the blood thiocyanate level Similarly biopsy of the adrenal cortex of sympathectomized patients with essential hypertension was done before and after thiocyanate therapy Sections showed striking depletion of lipids in all three layers, but particularly in the zona glomerulosa

In dogs with experimental hypertension histologic studies of the adrenal cortex were made before and after sympathectomy and with zero and high blood thiocyanate levels A normal dog with a level of 9 15 mg /100 cc showed uniform depletion of lipids in all cortical layers A dog with experimental hypertension and a level of 36 mg /100 cc showed a fall of blood pressure from 200 to 170 mm. Hg after administration of cyanate and very striking depletion of lipids in all layers but particularly in the zona glomerulosa At the time of the high blood level the dog was apathetic and did not eat After the thiocyanates were stopped the blood level reached zero the animal improved clinically, the blood pressure rose to 238 mm Hg and the lipids reappeared in the adrenal cortex Bilateral thoracolumbar sympathectomy was then performed, blood pressure falling to 150 mm only to rise after 24 hours to 210 mm Hg Thiocyanate was ineffective in reducing the blood pressure for two months, after this, with a blood level of 40.2 mg /100 cc., it produced a persistent fall in blood pressure to 160 mm. Hg without anorexia or apathy At this stage, biopsy of the adrenal cortex showed strikingly greater depletion of lipids than before sympathectomy, especially in the zona glomerulosa.

A low grade hepatic disorder was produced in dogs by partial occlusion of the portal vein, with a view to gradually reducing production of hypertensinogen There was striking depletion of lipids in the zona fasciculata and zona reticu

laris, and only relative depletion in the zona glomerulosa. It is to be noted that the depressor effect of a chronic, mild liver insufficiency is accompanied by a depletion pattern of the lipid granules in the adrenal cortex different from that produced by the thiocyanates.

In an experiment on 18 dogs the initial dose of sodium thiocyanate produced an immediate drop in blood pressure that was followed by a prolonged rise, following which it returned to the original level. After removal of the adrenal glands from the dogs sodium thiocyanate caused the same drop but without the secondary rise, and the blood pressure returned very slowly to its original level and, in fact, often remained lower

In the normal animal thiocyanates apparently call forth a pressor response from the adrenal glands to balance the pronounced initial depressor action. In the hypertensive dog or patient this pressor effect is already in command and the depressor effect of the thiocyanates is much more gradual and less direct

Thiocyanate depletion of lipids in the adrenal cortex occurs similarly in hypertensive patients and dogs with experimental hypertension, but it is more striking in dogs with experimental hypertension after bilateral sympathectomy The depletion is associated with inhibition of function of the adrenal cortex. Moreover although in patients with the high diastolic type of essential hypertension sympathectomy alone does not reduce blood pressure, subsequent administration of thiocyanates does alter it and favorably affects the clinical course of the disease

These observations show that thiocyanates and sympathectomy affect principally the glomerulosa layer of the adrenal cortex. Cytochemical studies of the lipid granules have indicated that this layer is the important source of the 17 ketosteroids

Observations on Results of Subtotal Adrenalectomy in Treatment of Severe, Otherwise Intractable Hypertension and Their Bearing on Mechanism by Which Hypertension Is Maintained are presented by Charles C Wolferth, William A. Jeffers, Francis D W Lukens, Harold A Zintel and Joseph H. Hafkenschiel[3] (Univ of Pennsylvania) In 23

(3) Ann Int. Med. 35 8-18 July 1951

patients who had subtotal adrenalectomy 8 of the first 11 survived at least five months, 11 of 12 more recent patients have survived over one to three months All had severe hypertension with its other characteristic manifestations and were unresponsive to medical treatment In each of 16 patients treated before this study, one adrenal gland had been removed during the second stage of a thoracolumbar sympathectomy Some patients have been followed almost two years after operation, but for the group as a whole the cases are too few and the period of follow up too short to state whether unilateral adrenalectomy has improved results of thoracolumbar sympathectomy alone Results to date have not been significantly different There has been no evidence of adrenal insufficiency in this group

Subtotal adrenalectomy alone was performed in nine patients Three patients died one of pneumonia and adrenal insufficiency in the immediate postoperative period and two of recurrence of cerebral vascular seizures within two months of the procedure Two of the six surviving patients have shown excellent results five and eight months after operation (10% of one gland and 5% of the other were left in situ) Both require supportive treatment, one of 3 mg cortisone daily the other of 25 mg cortisone and 1 mg DCA orally daily With careful regulation of cortisone blood pressure has been kept normal and congestive heart failure relieved specific cardiac medications are no longer needed In a third patient, with similar amounts of adrenal tissue left in situ and no supportive treatment required, immediate results were excellent, but seven months later hypertension was again developing However, headaches have been completely relieved In the other cases, with less adrenal tissue removed, results have been varied and inconstant However there was some temporary reduction of hypertension and symptomatic improvement. In one patient in whom a Peet type sympathectomy had brought no improvement, a 90% subtotal adrenalectomy though causing only small changes in blood pressure, completely relieved congestive heart failure

After these experiences six patients were treated by leaving in situ a small fragment of adrenal (less than 1 cm in any diameter) sectioning of the splanchnic nerves on

both sides and removal of paravertebral ganglions from 12th thoracic through 2d lumbar In five of these, early postoperative results have been excellent. No blood pressure response occurred in the sixth who, however has shown no adrenal insufficiency Two patients with advanced renal disease had adrenalectomy only they have shown notable decrease in the blood pressure in the few months since the operation. In three of four patients operation was too recent for results to be significant, the fourth patient died. It is concluded that the combination of subtotal (90-95%) adrenalectomy and sympathectomy has given promising results in their preliminary studies. With careful supervision, replacement therapy with cortisone DCA and salt has not been a major problem. Further if this combination of surgical treatment proves successful, eventual medical treatment of hypertension becomes more likely It would point toward the medical control of the sympathetic nervous system activity and the depression of adrenal cortical function

Operative Anatomy of Lumbar Sympathetic Chain. Edward A. Edwards[4] (Harvard Med School) examined 40 lumbar sympathetic chains in 20 male bodies by gross dissection, noting their form, connections and relations to neighboring structures By following each ramus communicans to the somatic nerve with which it connects the proper segment of the sympathetic trunk is established Ganglions or segments of the trunk and rami should be numbered according to the connections of the rami, rather than by numerical sequence of the ganglions as seen grossly Each sympathetic trunk lies quite far laterally on the anterior surface of the lumbar spine. The vena cava on the right and the aorta on the left lie anterior to the sympathetic chain on the corresponding side. Caudally each trunk is crossed by the common iliac vessels. On each side the sympathetic trunk lies anterior to the lumbar arteries, of which four are constantly present on the corresponding upper lumbar vertebrae with an occasional 5th artery on the 5th vertebra The trunk is situated in front of the lumbar veins which accompany the lumbar nerves, but some of them terminate in the ascending lumbar vein, leaving a variable number in the more medial position in relation to the sym

(4) Angiology 2:184 198, June, 1951.

pathetic chain Position of the diaphragm may be variable An intermediate crus may hide much of the trunk The levels of the diaphragm and the iliac vessels are not trustworthy landmarks of the nerve segments

As the sympathetic trunk continues down from its thoracic position over the head of the 12th rib, it curves forward to reach its lumbar position on the anterior surface of the spine In its transition from 12th thoracic to 1st lumbar segment, the trunk may be very slender, probably not exceeding 1 mm In the intervals between ganglions Its rounded form usually changes below the 4th lumbar level and deep to the iliac vessels, to a plaited appearance comprising three or four fine parallel cords Of these, one is the trunk proper, one may be a ramus to the 5th lumbar nerve, and one or two may be visceral branches Collaterals of the trunk are said to exist only between two ganglions Very fine collaterals may actually be encountered along the medial edge of the psoas extending over several segments contributed to by several filaments, often connecting with the genitofemoral nerve or continuing as a separate nerve to the external iliac vessels Ganglions appear at irregular intervals on the trunk, those for the upper rami being especially subject to fusion The 4th ganglion is frequently distinct, while the 5th is almost invariably separate from the others The total number of ganglionic masses visible is usually three or four A ganglion is generally elongated or fusiform in appearance with some of its thickness extended along the origin of the rami or visceral branches Intermediate ganglions include the frequent extension of a ganglion proper onto a ramus for some millimeters after the ramus leaves the main mass The rami communicantes vary in number from one to three for each lumbar nerve They arise from the trunk mainly at levels of ganglionic thickening but occasionally also in the segments between ganglions Each ramus usually reaches the edge of the psoas muscle in a small gap between the muscle and edge of the vertebra Some rami join collaterals, while others enter the genitofemoral nerve the external spermatic or external iliac constituents of the genitofemoral nerves

The location of origin of the rami from the trunk, though variable was found to vary only within certain limits,

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(4) Angiology 2:184 198 June 1951

which could be related to vertebral levels The relation of sympathetic chain segment to vertebral level and the range of variation of this relationship from the 12th thoracic to the 5 lumbar segments were studied to propose an accurate means of identifying trunk segments at operation. An accurate counting of the lumbar vertebrae or disks necessary in this determination is possible by using the iliac crests as a landmark Review of 100 x ray films indicates that the height of the iliac crests varies from the 3d disk to the 5th body with males generally possessing a high level and females a low one The iliac level in the individual must therefore be determined preoperatively by x ray study

Removal of the 2d and 3d lumbar segments of the chain may be accomplished by an excision extending from the upper edge of the 2d lumbar vertebra to the lower edge of the 3d disk Such excision will remove the 1st lumbar rami in most patients and the 4th in some This study casts no light on possible disturbance of sex function by such excision. As to sympathetic pathways the more extensive the removal of the chain, especially upward the less likelihood will there be of postoperative residual sympathetic activity Intermediate ganglia upon the rami or anterior lumbar nerve roots probably function independently of the sympathetic trunk A conventional sympathectomy will leave intact most of the intermediate ganglia but some may be secured by dividing the rami as far out as possible in the hiatus beneath the psoas muscle The genitofemoral nerve is intimately connected with the lumbar sympathetic trunk via rami and collaterals The term external iliac nerve is proposed for the prominent branch of the genitofemoral nerve or for the occasionally independent structure described here which supplies the external iliac artery and vein.

Technic for Lumbar Sympathetic Ganglionectomy, a modification of Flothow's anterolateral extraperitoneal approach is described by John L Madden[5] (State Univ of New York, Brooklyn)

METHOD —The patient is supine, and the side to be operated on is elevated to about 25 degrees to the horizontal. Spinal anesthesia is used, and a muscle splitting incision is made (Figs. 95,*A-C* and

(5) Am. J Surg 83 698-702 May 1952

wise troublesome difficulties may ensue. When the vertebral column is reached, further blunt digital dissection is continued first upward and then downward in the same plane. To maintain retraction of the peritoneum, a wide type Harrington retractor is inserted. At this time the ureter is identified and retracted from the field (*H*) Dissection is continued in the upper portion of the wound, and the

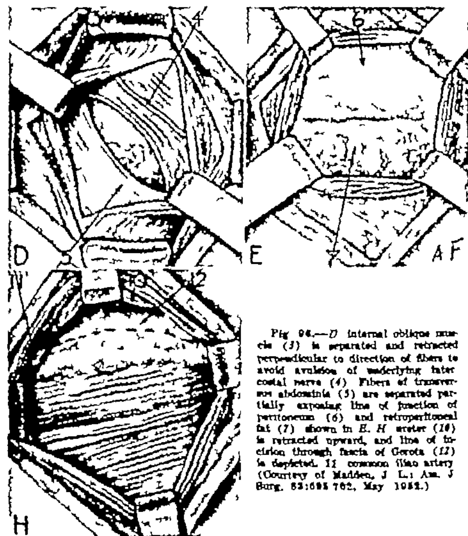


Fig 96.—*D* Internal oblique muscle (*3*) is separated and retracted perpendicular to direction of fibers to avoid avulsion of underlying intercostal nerve (*4*) Fibers of transversus abdominis (*5*) are separated partially exposing line of junction of peritoneum (*6*) and retroperitoneal fat (*7*) shown in *E*. *H* ureter (*10*) is retracted upward, and line of incision through fascia of Gerota (*12*) is depicted. 11 common iliac artery (Courtesy of Madden, J L.: Am. J Surg. 83:695 702, May 1952.)

lower pole of the kidney is retracted upward. In a similar manner dissection is continued downward and suitable retraction is maintained. Gerota's fascia is then opened by blunt dissection. On the right side the vena cava is partially mobilized and gently retracted medially On the left side the aorta is located well medially; its mobilization is unnecessary The genitofemoral nerve is readily visible on the medial aspect of the psoas muscle. The areolar and lymph

node tissues paralleling the vertebral column are separated by blunt dissection On completion of this dissection, the lumbar vessels and sympathetic trunk are exposed along the anterolateral aspect of the vertebral column Further identification of the sympathetic trunk is obtained by palpation, and it is then mobilized on a nerve hook. By sharp dissection the trunk and its ganglions are completely mobilized before division and segmental resection. On the right side caution is necessary in mobilization of the lower portion of the chain because of the anterior location of the lumbar vessels When this obtains it is necessary either to divide the chain above and by traction below deliver it from behind the lumbar vessels or to divide and ligate the overlying vessels. For hemostasis use of silver brain clips is preferred. After segmental resection of the sympathetic trunk and ganglions, the wound is irrigated with saline solution, and complete hemostasis is obtained. The retractors are removed and the wound layers immediately approximate themselves. The patient is allowed out of bed the evening of the day of operation or the following day and may be discharged within five to seven days.

In this operation the fourth lumbar ganglion is routinely removed Objections against its removal on the basis that a postganglionic sympathectomy would be performed and unsatisfactory results obtained have not been borne out

Segments of the ureter genitofemoral nerve and a chain of lymph nodes reportedly have been mistakenly resected for the lumbar sympathetic trunk. The ureter is mobile, white and nonganglionated and is located anteriorly It is accompanied by periureteral vessels and contracts when pinched. The genitofemoral nerve is located along the medial aspect of the psoas major is white and nonganglionated and in its lower portion deviates obliquely downward and lateralward The lymph nodes are yellowish brown, more superficially located friable and readily mobilized

Technical Aspects of Surgery of Hypertension with Follow up of 50 Cases. Douglas Miller[6] (Sydney) reports results with an adaptation of Fey's renal approach, the longest follow up period being five years

Technic.—An incision is made along the line of the 11th rib from the outer edge of the sacrospinalis forward into the lateral abdominal wall (Fig. 97) The soft tissues are separated subperiosteally along the length of the upper surface of the rib, and the flank muscles which arise anteriorly are separated. The rib is depressed, exposing the diaphragm, pleural reflection and subphrenic fat (Fig 98) The subphrenic space is opened, and the kidney and adrenal are explored. The greater splanchnic nerve is isolated and divided the lumbar chain is followed down and divided at the desired level

(6) Australian & New Zealand J Surg 20 255 258 May 1951

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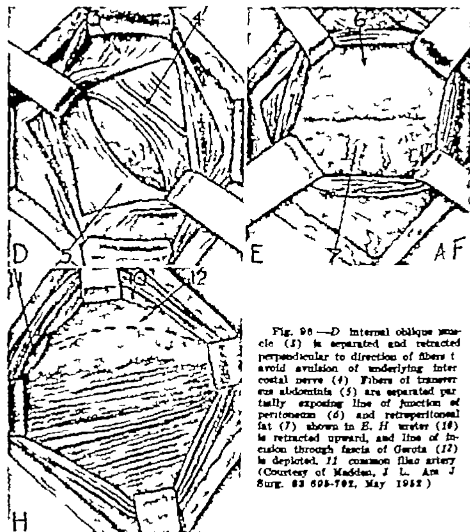


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(6) Australian & New Zealand J Surg. 20 265 288 May 1951

then followed upward and isolated from the rami as far beneath the arcuate ligament as possible without dividing the anterior part of the diaphragm. Retropleural dissection is done, the pleura usually pushing away readily from the chest wall. The chain and splanchnic nerves are followed up to about the level of the 7th thoracic vertebra, where they are divided. The splanchnics and chain are then pulled up through the diaphragm and removed in one piece.

Expert anesthesia is essential, especially in view of alarming fluctuations of blood pressure and the frequent opening

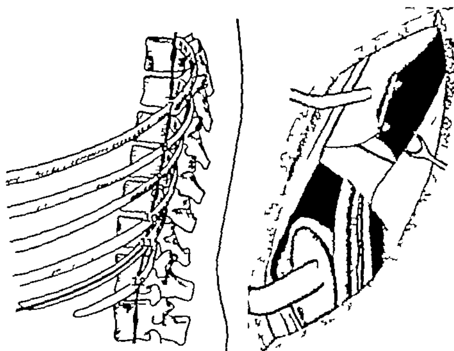


Fig. 97 (left) —Line of incision.
Fig. 98 (right) —Eleventh rib has been depressed and intercostal space widely retracted. Note wide exposure obtained above and below diaphragm and ready access to kidney
(Courtesy of Miller D Australia & New Zealand J Surg 20-285-288 May 1951)

of the pleura. Relaxant drugs are useful. In bad risk patients, more limited operations are indicated.

One complication of this operation is vasomotor collapse associated with immediate postoperative movement which can be combated with vasopressor drugs. Miller insists that full recovery take place before the patient is returned to the ward. Other complications include pneumothorax and effusions severe hypotension causing alarming cerebral anemia, and transient and apparently severe backache

Of 39 patients who sought symptomatic relief from headache, fatigue giddiness and/or emotional instability, 24 experienced complete 9 partial and 5 no relief One was incapacitated by hypotensive symptoms Often symptomatic relief came without much drop in blood pressure Two patients died in the immediate postoperative period Although one patient with severe hypertension had no objective postoperative fall in blood pressure, relief was such that she enjoyed normal life for a year, when she died of apoplexy

Eleven patients had few, if any, symptoms but sought operation with a view to increasing life expectancy Six had no change in blood pressure and four of these died within a year All were *men near 50 Four maintained* a substantial drop or had normal blood pressure There was one operative death.

Results indicate that the operation on men approaching age 50 does not yield worthwhile results, whereas prospects for young adults are more hopeful It is better to look on the operation not as a cure for high blood pressure but as one to bring relief from its effects

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PERIPHERAL VEINS THROMBOPHLEBITIS

Some Basic Observations on Venous Thrombosis and Pulmonary Embolism. In addition to routine autopsy on 100 men over 40 John McLachlin and J C Paterson[7] (London, Ont) searched the pulmonary arteries and their branches by the "open book' method and studied all gross emboli microscopically

Gross venous thrombi were found in 34 cases, 56% of them resulting in pulmonary embolism. Incidence of thrombosis was the same in young and old. In 15 cases the thrombosis was bilateral, in 14 on the left and in 5 on the right Of 76 individual thrombi in the 34 cases, 6 were in pelvic veins, 49 in thigh veins and only 21 (27%) in leg veins, the thigh veins obviously being the commonest site for thrombosis. In 21 cases the thrombosis was so situated that usual superficial vein ligation would not have prevented pul

(7) Surg Gynec. & Obst 93 1-8 J 1 1951

monary embolism. Besides, superficial vein ligation does not seem sound because in 10 per cent of the cases the main drainage pathway from the calf was by the profunda femoris, not by the superficial femoral vein. Thrombi arose in direct relation to a valve pocket in 31 per cent of the cases Primary pulmonary embolism appears to be non existent, since all the authors' cases were secondary Differentiation between thrombophlebitis and phlebothrombosis is not only valueless but dangerous, for pulmonary embolism occurred in four of the five cases of thrombophlebitis. In two of these there was no associated bland thrombus, while in the other three, only two of which were embolic, there was bland thrombus in the opposite leg Serial sections did not show any intimal changes which might act as a precipitating factor in thrombus formation. One case of pulmonary embolism was associated with portal cirrhosis, contrary to observations reported by others. Constricting bands in the neighborhood of the veins were not demonstrable except in the leg where the soleus muscle takes its origin. Thrombi were found in the leg veins alone in only four cases.

No doubt the frequency of thromboses in the pelvic and thigh veins explains why so many cases are not diagnosed clinically Their detection would be facilitated by the finding of a clinical test similar to Homans', only related to thigh instead of leg veins.

[The conclusion that differentiation between thrombophlebitis and phlebothrombosis is valueless and dangerous is interesting and important.—Ed.]

Thromboembolism Analysis of Cases at Charity Hospital, New Orleans, over a 12 Year Period. Alton Ochsner Michael E. DeBakey Paul T DeCamp and Eudorico da Rocha[8] review 647 868 admissions, 32,254 of them fatal (excluding stillbirths) Autopsies were done in 33.9% Fatal pulmonary thromboembolism was diagnosed in 476 instances, with 383 confirmed at autopsy Forty per cent of the 1,223 cases of thromboembolism were fatal.

No significant difference in seasonal incidence of thromboembolism was observed. Peripheral thrombosis occurred in the lower extremity veins in 81% of cases (preponderance on the left side) and in the pelvic veins in 10% Incidence of suppurative pelvic thrombophlebitis increased up to 1946

(8) Ann. Surg. 134 405-419 September 1951

and remained stationary since then, whereas other suppurative thrombophlebitis has decreased since 1946

Highest incidence of pulmonary emboli was on the medical service, with 174 fatal and 34 nonfatal cases/100 000 admissions Furthermore the ratio of fatal pulmonary embolism to all hospital deaths showed a striking parallelism in the case of the medical service, viz., 54% of the fatal pulmonary embolisms and 52% of all hospital deaths A discrepancy difficult to explain is the relative immunity of tuberculous patients to fatal pulmonary embolism (11% of all hospital deaths, but only 1.3% of fatal pulmonary emboli) Relatively low incidence of fatal pulmonary embolism on the obstetric service is presumably due to the fact that thromboembolism complicating obstetrics is usually the nonsuppurative thrombophlebitic type, with the clot firmly attached to the vein wall.

The number of nonfatal pulmonary emboli has increased on all but the obstetric service, and the number of fatal pulmonary emboli on all but the gynecologic and obstetric services The decrease in number of fatal emboli on the gynecologic service is attributed to ligation of the ovarian veins and vena cava and use of antibiotics and transfusions A relatively low mortality rate maintained on the surgical service is attributed to early recognition and prompt ligation of the vessel Heart disease had a 25% rate of fatal pulmonary embolism and 41% of the pulmonary emboli occurred in these cases

Thrombophlebitis is attributed to perivenous lymphangitis and secondary changes in vascular endothelium, whereas phlebothrombosis results from alterations in blood constituents in favor of clotting together with stasis Alterations of blood constituents are apparently proportional to the degree of trauma including infection and neoplastic tissue destruction Blood clotting seems to take place when there is a decrease in antithrombin of the plasma Despite past efforts to overcome stasis, in about 40% of cases of fatal pulmonary embolism there was no antecedent clinical evidence of venous thrombosis

Many types of therapy were used. Pulmonary embolism in untreated patients was 88% fatal Vein interruption was employed in 201 patients and no emboli developed in 71

phlebothrombosis cases, in 33 nonsuppurative thrombophlebitis cases or in 27 septic thrombophlebitis cases. Some of the venous interruptions failed because clots already existed proximal to the ligation. Incidence of failure of vein ligations in all potentially dangerous cases of phlebothrombosis, suppurative thrombophlebitis and pulmonary embolism was 4 8% and in those cases in which embolism had already occurred, 11 4% Because the fatal emboli in some of the vein ligations originated proximal to the site of ligation or came from pelvic veins, inferior vena caval ligation is now deemed preferable to superficial vein ligation in extensive phlebothrombosis.

Anticoagulant therapy resulted in severe hemorrhage in 4 and in fatal embolism in 7 of 109 patients so treated. It appeared useful in advanced heart disease, since 18 of 31 such patients survived with anticoagulant treatment and only 12 of 233 without it. It failed in 10 6% of those with dangerous phlebothrombosis, suppurative thrombophlebitis and pulmonary embolism.

Increasing incidence of thromboembolism despite all measures makes additional therapeutic agents or procedures imperative Prevention of decrease in antithrombic content of plasma from operative trauma was attempted with a combination of alpha tocopherol and calcium intravenously sufficient to give an antithrombin level of 1 16 and a prothrombin time of 15 seconds Of 96 untreated patients with antithrombin levels less than 1 16 23 developed intravascular clotting 5, fatal pulmonary emboli, and 1, cerebral thrombosis. On the other hand, 442 of 457 patients given alpha tocopherol and calcium had antithrombin levels of 1 16 or above, 2 with antithrombin levels below 1 16 had fatal pulmonary embolism. Because of the unpleasant effects of calcium given intravenously it is hoped that another antithrombic substance may be found for routine use

Response of Clotting Equilibrium to Postoperative Stress. Geza de Takats and Millard H. Marshall[9] (Chicago) followed the daily changes in the clotting mechanism before and after operation by determining the clotting time of 1 cc. venous blood It was added to a clean test tube containing 1 gamma of heparin in 0 1 cc physiologic saline solution.

(9) Surgery 31 13 27 January 1952.

Other tests performed were the heparin tolerance test, Thorn's test and response of clotting time to injection of epinephrine The sensitized venous clotting time and daily eosinophil count showed fluctuations which place the response of the clotting mechanism to surgery among the manifestations of Selye's general adaptation syndrome Different patterns exist in response to epinephrine administered before operation Eight of 26 patients showed a fall in eosinophils together with lengthening of clotting time, whereas in the rest both eosinophils and clotting time moved in the same direction Young healthy, normal patients responded to this "microstress" with lengthening of clotting time or rapid recovery from its shortening

The effect of nonspecific stress on the clotting mechanism depends essentially on two factors state of the pituitary corticoadrenal axis, and available resources of the clotting system to cope with the initial clotting tendency

Deep Venous Thrombosis in Leg Following Effort or Strain. On the basis of 23 cases, 10 from the literature, Chilton Crane[1] (Harvard Med School) suggests that effort or strain is the chief causative factor in many cases of venous thrombosis in the lower extremity in active, healthy persons. The primary lesion seems to be an injury to the wall of a main venous trunk, often at a valve wall junction, with thrombus formation in the classic pattern following at the site of injury

In most cases fixation of the diaphragm and contraction of the abdominal musculature during strenuous effort as in straining lifting or jumping produce a sharp elevation in venous pressure in the vena cava which is transmitted to the femoropopliteal veins. During severe effort of the legs the large flat muscles of the calf and the quadriceps group of the thigh contract simultaneously compressing the great veins of the calf sharply against the posterior tibial wall Violent muscular contraction, added to high venous pressure may contuse the thin walled vein, bruise the vasa vasorum or in association with muscle tear rupture a venous branch at its point of origin, thus tearing a hole in the wall of the main venous trunk. Extreme anatomic venous angulation in the popliteal space as in kneeling or squatting pro-

(1) New England J Med. 246 529 533 Apr 3 1952.

duces peripheral venous engorgement that may be injurious.

Deep venous thrombosis must be differentiated from muscle strain. The stiffness, pain and disability of the latter are due to hematoma formation and approach their height in 4-24 hours, the stiffness, pain and disability of venous thrombosis follow the gradual establishment of a sufficient degree of venous blockade, which usually requires from 2 to 7 days. The edema of muscle strain (if any) appears early and is only local, whereas that of venous thrombosis appears late and is diffuse The tenderness of muscle strain is localized that of venous thrombosis follows the course of the vascular trunks or may be diffuse

Strict bed rest, elevation and compression bandaging of the legs and leg exercises, until all signs and symptoms have subsided, constitute the best therapeutic regimen. Although pulmonary embolism is rare the addition of anticoagulants in desirable Femoral vein division should not be considered unless pulmonary embolism has supervened or unless signs and symptoms persist after six to eight weeks of conservative therapy

Acute Massive Venous Occlusion in Lower Extremity John T Ellis and S W Windham[2] (Frasier Ellis Hosp Dothan, Ala) report two cases.

CASE 1 —Man, 62, was hospitalized with moderate orthopnea. Weakness and dyspnea on exertion had been present for four months. Urinalysis showed 3 plus albumin. He improved on digitoxin and sedation therapy, but on the seventh hospital day pain in the right chest and hemoptysis developed, and on the next day severe pain in the entire left leg groin and lower abdomen The left leg became swollen, deep blue and cold in 30 minutes. The superficial veins were engorged, and no arterial pulse could be felt below the thigh. Sympathetic block gave no relief. After about six hours, operation was done. No gross arterial abnormality was encountered but an extensive clot was found in the superficial femoral vein, and on further exploration clots were also found in the external and common iliac veins. The clots were removed, and the common iliac vein was ligated. The right leg became edematous on the second postoperative day Chest pain improved, but despite daily sympathetic blocks discoloration or edema was not relieved and he became more dyspneic, with hiccups and anuria, and died on the fifth postoperative day Permission for autopsy was refused, but death was believed to be of cardiac origin rather than secondary to pulmonary embolism and infarction.

(2) Ann. Surg. 136 262 266 February 1952

CASE 2.—Man, 67, had severe cramping pain of sudden onset in the left groin and leg, followed by swelling, numbness and bluish red discoloration of the leg but without local coldness. The superficial veins were engorged, but the dorsalis pedis and popliteal pulsations were normal on hospitalization six hours after onset. Two hours later the left femoral artery and vein were explored. The artery was grossly normal, but the superficial femoral vein contained an extensive clot, which was sucked out with ensuing active retrograde bleeding. The intima was glistening and smooth. The vein was ligated. Lumbar sympathetic block was done for three days. Two weeks later he was discharged without edema. He has returned to work as a pharmacist and had no complaints.

Acute massive venous occlusion should be suspected when there is sudden severe pain, deepening cyanosis, pronounced venous congestion and rapidly developing edema. Arterial spasm may obliterate arterial pulsations, but arterial blood is also kept from reaching the tissues by the extreme venous pressure built up by the extensive venous occlusion. This circulatory arrest results in gangrene, especially when augmented by venospasm. Differential diagnosis includes iliofemoral thrombophlebitis with reflex arteriospasm and signs of vascular deficiency, which last only a few hours and are relieved by lumbar sympathetic block, peripheral arterial embolism, in which the involved extremity is usually cold and blanched, and acute peripheral circulatory failure, which is characterized by loss of pulse in all extremities. In acute massive venous occlusion a shocklike state may result from excessive fluid loss into the involved extremity, but this responds rapidly to blood transfusion.

Sudden onset of acute massive venous occlusion indicates impending gangrene. Lumbar sympathetic block does not bring improvement. Immediate removal of the extensive clot from the femoral vein is advocated. Improvement followed removal of clots in Case 1, though death occurred five days after operation. Postoperative limb elevation and exercises are advised.

Silicone Tube Coagulation Time as Aid in Diagnosis of Phlebothrombosis is evaluated by Robert S. McCleery, John A. Yarborough and Michael G. Weidner, Jr.,[3] (Nashville, Tenn.) Of 4,836 patients operated on over 2¼ years, 273 were selected as in whom phlebothrombosis was most likely to develop. Preoperative and daily postoperative silicone

(3) Surgery 31 28-42, January 1952

coagulation time determinations were made on these In addition, any of the other hospital patients in whom or symptoms suggestive of venous thrombosis deve were checked for the silicone coagulation time. In al patients were checked Fibrinogen B, prothrombin time White coagulation time and blood viscosity were als termined daily on many of these patients for compa

Three precautions are necessary in the test (1) The

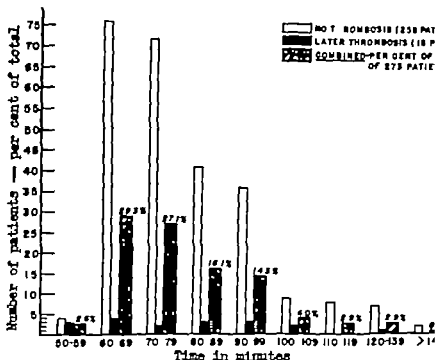


Fig. 99 —Normal preoperati e silicone tube coagulation time and developed postoperative phlebothrombosis. (Courtesy of McCleery R. S., et al Surgery 42 January 1952.)

puncture must be nontraumatic, since a small amoun thromboplastin liberated through trauma will greatly sl en coagulation time with this sensitive test (2) exces agitation of the tubes must be avoided, and (3) the must not be made within three hours of the intramusc injection of penicillin. Before considering a test posi it is repeated with the patient at bed rest and rechec 12 hours later If all coagulation times are 45 minute below, the test is considered positive and active ther initiated.

Evidence of phlebothrombosis developed in 18 (6.5%) of the 273 patients. These patients had silicone coagulation times of 20-45 minutes together with mild leg signs The false positive rate was low Normal preoperative silicone coagulation times in the 273 patients are shown in Figure 99 In the 2 6% with preoperative times of 50 59 minutes, phlebothrombosis developed postoperatively in almost half It therefore would appear that this group should be followed especially carefully with daily postoperative silicone coagulation time determinations

Of all types of tests performed, only the silicone coagulation time seemed to have diagnostic value in the clinical problem of phlebothrombosis and pulmonary embolism Unfortunately even the silicone coagulation time had no predictive value since it was normal the day before the disease occurred The merit of the silicone coagulation time appears to be early diagnosis Three days from the onset of thrombotic disease clotting time may be again normal It is to be stressed that only phlebothrombosis is accompanied by these silicone coagulation time findings In all 25 patients with thrombophlebitis clotting time was normal

Administration of Heparin is discussed by Ivan F Duff James W Linman and Roberta Birch[4] (Univ of Michigan) This valuable anticoagulant can sometimes be used when dicumarol® is contraindicated Combined heparin and dicumarol® therapy is often indicated Contraindications to administration of heparin are threatened abortions, potential hemorrhagic diathesis, increased capillary fragility suspected intracranial hemorrhage and actual or potential bleeding from the gastrointestinal tract Heparin should not be used in subacute bacterial endocarditis or if urine output is decreased Although the risk of heparin induced bleeding is not great it should not be minimized in the immediate postoperative period Protamine sulfate is a valuable and rapid acting antagonist to this drug A few instances of untoward reactions to heparin of an allergic nature have been reported Aqueous sodium heparin may be administered intravenously subcutaneously or intramuscularly Special long acting preparations are available for subcutaneous or intramuscular deposition.

(4) Surg., Gynec & Obst. 93 343 362 September 1951

The effect of heparin on clotting time is measured by the simple Lee and White test. Opinions differ as to what constitutes an adequate therapeutic effect from the drug The authors consider prolongation of clotting time to twice the pretreatment figure to be an adequate and moderate effect. Unless meticulous attention is paid to details of administration, an irregular alteration of clotting time is the rule From existing data, no conclusion can be drawn as to the virtue of a sustained effect in contrast to an irregular picket fence type of reaction.

There are also conflicting opinions regarding the necessity for clotting time determinations. The authors believe they should be done An adequate dose, injected directly and full strength into a vein, produces a reasonably constant and predictable alteration of clotting time This fact, and the apparent rarity of resistance to intravenously administered heparin perhaps justifies omission of these determinations when the drug is given in this manner to selected patients. When depository heparin is used, an occasional heparin resistant patient may be encountered. This is sufficient reason for requesting appropriately spaced determinations. A sustained, yet moderate elevation of clotting time the cardinal virtue of continuous infusion of heparin, can be obtained only with repeated clotting time determinations

The controversy as to the best method of heparin administration may be partially resolved by recognizing that varying circumstances should determine the modality used. Direct, intermittent administration of undiluted heparin into the vein is a widely used and indisputably successful form of therapy The immediate effect on the clotting mechanism is often highly desirable but may be a serious hazard if hemostasis is incomplete The inconvenience of repeated vein punctures constitutes the chief disadvantage

The convenience of depository heparin, as contrasted with intravenous injections, explains the growing popularity of this method. A 'priming' dose of aqueous sodium heparin intravenously followed by intermittent subcutaneous injection of relatively small doses of the same product (Cosgriff method) produces a moderate and fairly well sustained elevation of the clotting time Deep subcutaneous or intramuscular injection of aqueous sodium heparin in

doses of 100-200 mg satisfactorily alters the clotting time for 5 10 hours This effect can be prolonged for about 24 hours when the special depository preparations are used in doses of 200-400 mg The authors have observed no practical prolongations of effect by use of vasoconstrictors. In most patients a variable period, 2 5 hours, elapses before clotting time is significantly altered by these preparations.

Local discomfort incident to injection of all heparin preparations beneath the skin is a disadvantage which should not be minimized Although pain and aching may usually be relatively well controlled, discomfort sometimes is sufficient to preclude further injections The amount of heparin required for effective treatment will be about the same regardless of method of administration

[This is a very good summary of current opinions about the best way of administering heparin.—Ed.]

Administration of Heparin. J Erik Jorpes Harry Boström and Aasmund E Roch Norlund[5] (Karolinska Inst.), point out that the usual 5% heparin solution fails to act satisfactorily when given subcutaneously The effect on coagulation time is about one third to one fifth of that produced by heparin given intravenously and is therefore inadequate for treatment of thrombosis. Here failure may mean progression of the acute leg symptoms with resultant risk of pulmonary embolism and more severe post-thrombotic sequelae Severe pain usually follows subcutaneous injection of heparin and is not relieved by injection of hyaluronidase When heparin was given subcutaneously to four patients, the highest coagulation times were seven to nine minutes.

Heparin given intramuscularly does not have the same immediate and satisfactory influence on the thrombotic process as when given intravenously It is difficult to evaluate the effect of this form of therapy on thrombosis, but recurrences were more frequent with it, than with intravenous administration. Large hematomas occurred at the site of intramuscular injection in 7 of 41 patients

The intravenous route is the only good one Heparin is given either in a continuous drip of saline solution or in intermittent injections of large doses, usually four times a day Most authors prefer intermittent injections, usually

(5) Acta chir scandina 101 279 84 1951

without control of coagulation time The bleeding tendency is minimal except in patients recently operated on. It is extremely important to give heparin in large enough doses during the initial phase of treatment of an acute thrombosis or pulmonary embolism. The dose can be determined by the heparin tolerance test. Various persons show a quite different response to a definite dose The test permits determination of the individual need for heparin and detection of hyporeactors Dicumarol® must be administered regularly to maintain a constant low prothrombin level.

Response of Dicumarol® Induced Hypoprothrombinemia to Vitamin K_1 was studied in 62 patients by Alfredo Rehbein, Alfred Jaretski, III, and David V Habif[6] (Columbia Univ) An emulsion containing 50 mg /ml vitamin K_1 was used. Particle size under the phase microscope was less than 1 μ. The emulsion was stable and effective after four months when protected from light. Found safe for intravenous administration, it reversed hypoprothrombinemia due to dicumarol® as well as to the other available prothrombin depressing drugs (tromexane phenylindanedione and compound 63) Doses of 50 mg consistently returned an elevated prothrombin time to normal, or nearly normal, levels in about six hours, irrespective of degree of hypoprothrombinemia and amount of recently administered prothrombin depressing drug In most instances this dose also maintained the prothrombin time at normal levels without subsequent rebound. After excessive dosage of a prothrombin-depressing drug, the 50 mg dose may have to be repeated in 6-12 hours for several doses. Normal response to subsequent doses of dicumarol® may be expected after 50 mg vitamin K_1

Vitamin K_1 emulsion controls bleeding from dicumarol® induced hypoprothrombinemia by permanently correcting the coagulation defect more rapidly than any other agent. Use of whole blood and plasma is obviated except when blood volume replacement per se is required. Large doses of the water-soluble preparations of vitamin K require 12 48 hours and often longer to correct coagulation defect. Doses of 0.5 2.5 mg vitamin K_1 reduce high prothrombin time to a safe therapeutic range when small doses of dicumarol® have been administered.

(6) Ann. Surg 135 454 460 April 1952

Efficacy of Hemostatic Agents in Presence of Anticoagulant Therapy was tested in dogs by Harold Laufman, Frederick W. Preston and Robert Bourdeau[7] (Northwestern Univ.) in view of clinical impressions of the efficacy of gelatin sponge in controlling hemorrhage in the operative wound of the heparinized patient in four instances of embolectomy.

METHOD.—Under intravenous pentobarbital anesthesia the dog's spleen was exteriorized and 4 10 rectangular segments (1.5 × 0.25 × 0.25 cm.) were removed from the anterior central portion. Four categories of anticoagulant therapy were used (1) aqueous heparin before and during surgery, (2) dicumarol* for 2 or 3 days preoperatively and 5 days postoperatively (3) aqueous heparin preoperatively and repository heparin for 5-7 days postoperatively, and (4) repository heparin or aqueous heparin and dicumarol* 2½-6 hours preoperatively and dicumarol* for 7 days postoperatively. Coagulation time was determined three times daily and prothrombin activity frequently checked. Safe therapeutic levels were considered as between 10 and 30 per cent prothrombin activity and between 15 and 30 minutes coagulation time. Various types of packing were used to control hemorrhage: frayed cotton covered with a cotton plaque, coarse mesh gauze and gelatin sponge covered with a gelatin sponge plaque. For comparison, some wounds were permitted to bleed freely.

When category 1 anticoagulant was used, the gelatin sponge was effective except in one dog with coagulation time of 180 minutes at operation in which, though immediate hemostasis was successful, late bleeding occurred. With category 2 anticoagulant the gelatin sponge controlled bleeding except that in one dog with 9.7 per cent prothrombin activity at operation, though hemostasis was then effective, prothrombin activity dropped to 1.7 per cent the next day and the dog bled to death from the splenic and abdominal wounds. With category 3 anticoagulant, variable prolongation of coagulation times was encountered and one animal, killed the seventh day, had hematoma of the spleen under the gelatin sponge but no free bleeding. Category 4 anticoagulants controlled bleeding in four dogs whose prothrombin activity and coagulation time was kept close to safe levels, but failed to control splenic bleeding in four other dogs whose coagulation times ranged from 40 to 120 minutes, even though in one dog it appeared effective at operation.

(7) A.M.A. Arch. Surg. 63 40-49 July 1951

The frayed cotton almost equaled gelatin sponge in hemostatic effect. Coarse mesh gauze did not control bleeding noticeably. In controlling bleeding, pressure was applied to the hemostatic substance at regular intervals and the resumption of bleeding noted. Hemostasis was ineffectual when bleeding could not be controlled in five minutes, even when pressure was exerted up to an hour. The shortest spontaneous bleeding time for the control wounds free of packing and pressure was 8¼ minutes. Gelatin sponge caused hemostasis in the same dog in one minute.

It is concluded that gelatin sponge effectively controls splenic bleeding in dogs under anticoagulant therapy when coagulation times and/or prothrombin levels are within or not far beyond the safe therapeutic levels outlined. Experiences in human beings appear to parallel these findings when gelatin sponge is used to control bleeding in skeletal tissues.

Present Status of Tocopherol and Calcium for Prophylaxis of Postoperative Phlebothrombosis is reviewed by John H. Kay[8] (Tulane Univ.). The component aspects of the problem considered are (1) evaluation of the antithrombin test as an indicator of a prethrombotic state, (2) effect of alpha tocopherol and calcium on antithrombin levels and (3) effect of alpha tocopherol and calcium on the incidence of intravascular clotting.

It was found that to produce phlebothrombosis not only must antithrombin be as low as 1:8, but it must also be accompanied by a normal or near normal prothrombin time. This combination indicates a prethrombotic state. It is proposed that evaluation of these two factors be called the prethrombotic index, with the term low prethrombotic index level being used to indicate a 1:8 antithrombin level with normal or near normal prothrombin time.

A control group of 246 patients receiving no antithrombotic therapy was studied. Among the patients with 1:8 levels and prothrombin times longer than 20 seconds there was only one instance of thrombosis—fatal cerebral thrombosis. On the other hand, among the patients with 1:8 antithrombin levels and prothrombin times shorter than 20 seconds on the same day, 23 had phlebothrombosis. There were

(8) Y le J Biol & Med. 23 516 521 June 1951

five deaths due to embolism Diagnosis of phlebothrombosis was based on calf tenderness, unilateral edema or dilation of the peripheral veins

A low prethrombotic level was present 6 72 hours before clinical symptoms of phlebothrombosis appeared To be of value, tests must be run daily, including Sunday Even so, the clinical syndrome often developed before the level had been determined Nevertheless, it was possible to ligate veins somewhat earlier than would have been possible without this advance information

Therapy consists in parenteral administration of 100 mg alpha tocopherol phosphate every eight hours, beginning immediately after operation and continuing until the patient can take oral medication. At this time 200 I U of alpha tocopherol acetate is given daily by mouth. In addition, 10 cc calcium gluconate is given every 24 hours intravenously

Of 457 patients treated by this routine, starting immediately after operation, only 15 had low antithrombin levels (1 8) Phlebothrombosis developed in 5 of the 15 and pulmonary emboli in 2 The incidence of fatal emboli in patients with a 1 8 level without peripheral signs of thrombosis was 2 per cent This is high enough to suggest the need of therapy in all instances of possible thromboembolism. It appears that the antithrombotic activity of the calcium salt of alpha tocopherol is significant in terms of preventing low prethrombotic index levels and consequent intravascular clotting

Late Sequelae of Inferior Vena Cava Ligation. Patrick C Shea, Jr., and Roy L. Robertson[9] (Grady Memorial Hosp., Atlanta, Ga.) followed 25 of 37 patients (average age 35) for two to seven years They were below average in economic and intellectual status. Before ligation, 27 had received conservative therapy 10 anticoagulant therapy and/or femoral vein ligation. Severity of the sequelae seemingly was not related to length of bed rest, elevation of legs or use of elastic stockings Lumbar sympathectomy or lumbar sympathetic block, when used, although effective in giving transient relief from postphlebitic pain, did not prevent or delay sequelae

(9) Surg., Gynec. & Obst 93 144 156 August, 1951

Two types of sequelae were found (1) peripheral arteriospastic phenomena (in seven patients), and (2) edema, which when persistent initiated the cycle of increased interstitial tissue protein, fibrosis, dermatophytosis and eventual ulceration. Only 1 of the 25 patients followed was symptom free Postoperatively 12 had never been without moderate to severe swelling of the legs. Seven others had intermittent swelling of the legs, more severe toward evening and disappearing after a night's rest. Intermittent claudication in the legs was present in 17 In 10 patients leg ulcers developed, in 3 they were intractable Prominent varicosities of the legs developed in 16 patients, in addition to 2 who had varicose veins before operation. Four patients had six uncomplicated pregnancies and two spontaneous abortions after caval ligation. Although pregnancy did aggravate preexisting edema in them, vena cava ligation per se did not interfere with normal gestation.

Of the 25 patients, 16 are employed full time Eight limit their activities because of symptoms. One is not employable largely because of sequelae of vena cava ligation, viz., pain, swelling edema, trophic changes, severe induration and tenderness of the calves and thighs, intermittent claudication, nocturnal leg cramps, small leg ulcers, eczema and severe venous stasis, although the patient also has gastric ulcer and mild cardiac decompensation. All reduce their disability somewhat by part time bed rest, elastic stockings, elevation of legs, Ace bandages and/or mercurial diuretics.

The dramatic immediate results of caval ligation justify it to save life when multiple pulmonary infarctions have taken place in a dangerously ill patient, particularly when other therapeutic measures have failed. However the late results do not warrant extending the indications to prophylaxis of thromboembolism. Furthermore there is no correlation between the immediate postoperative symptoms and late sequelae, e.g., some who were free from leg symptoms now show profound and incapacitating sequelae in the lower extremities. The late sequelae of vena cava ligation cannot be attributed to phlebitic disease alone

[It is hoped that this study of the late sequelae of inferior vena cava ligation will be widely read. There is too much of a tendency to think that the procedure is harmless.—Ed.]

Pulmonary Embolism Following Venous Ligation William G Anlyan Frank H Campbell, William W Shingleton and Clarence E Gardner, Jr (1) (Duke Univ) report results of treatment in 50 surgical patients with thromboembolic disease seen during one year Forty three received anticoagulants only and 7 were treated by venous ligations of whom 5 later had anticoagulation therapy because pulmonary emboli developed Of these seven, four had bilateral ligation of the superficial femoral veins two of the common femoral and saphenous veins and one of the popliteal veins

Thrombophlebitis of the lower extremities, which is merely a local manifestation of a generalized disease can be controlled only partly by superficial femoral vein ligation Workers have shown that this procedure may be followed by thromboembolism in fracture of the femoral neck Some of the conditions commonly listed in the literature as contraindications for anticoagulation and indications for venous ligation are: thrombophlebitis occurring (1) preoperatively or ante partum (2) after operation on the brain and spinal cord (3) after operations leaving large denuded surfaces or (4) in patients with hepatic or renal insufficiency However the authors believe that anticoagulation therapy supplants vein ligation in all these instances. They suggest that except in the presence of hepatic or renal insufficiency patients with preoperative thrombophlebitis be treated with heparin only for at least 48 hours before elective surgery at which time heparinization can be reversed within 15 minutes by administration of 50 mg protamine sulfate intravenously Six to 12 hours postoperatively heparinization can be reinstituted and dicumarol® given simultaneously The patient with hepatic or renal insufficiency can be treated with small doses of heparin only use of dicumarol® should be avoided

The only contraindication for anticoagulation therapy is in patients undergoing postoperative transurethral prostatic resection who bleed easily despite heparinization presumably due to the washing action of the urine In these cases inferior vena cava ligation is done This procedure may also be indicated when pulmonary embolism occurs despite heparinization regardless of the apparent source

(1) A.M.A. Arch. Surg 64 200 207 February 1952

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(1) A.M.A. Arch. Surg. 64:200-207 February 195_

In one patient superficial femoral vein ligation was done for localized symptoms in the right calf and at operation no clot was apparent, however, four days later pulmonary embolus developed. It appears incongruous to ligate a phlebitic vein proximally when it is already taxed by incompetent valves and areas of recanalization appear

A feeling of security from fatal pulmonary embolism after femoral vein ligation is not justified Use of anticoagulants need not be limited to large hospitals. Although dicumarol[*] should not be given where there are no facilities for determining prothrombin levels, there is no contraindication to giving 400 mg repository heparin (average dose) intramuscularly once daily The modified three tube Lee-White method for determining clotting time requires no special equipment and when done two or three times a day is adequate for evaluating heparin therapy

Plantaris Tenotomy in Claudication and Idiopathic Venous Congestion of Lower Extremities was successfully used by G F Norman and R. T Betts[2] (San Francisco) The plantaris, being a rather rudimentary and contracted structure, tends in some persons to shorten and become tense, producing venous stasis through the concomitant action of gravity and at times arterial circulatory disturbances also Faulty foot or body mechanics may further aggravate this effect. To counteract the squeezing effect on the vessels as they run between the popliteus and plantaris muscles (Figs. 100-102) *the plantaris is divided either by tenotomy or myotomy*

TECHNIC.—A 2 in. longitudinal incision is made below the popliteal fossa and a little laterally, with allowance for the lateral origin of the soleus and gastrocnemius. *The fascia is incised and the muscle* fibers are spread bluntly down to the plantaris, which is hooked up on a blunt retractor and severed. There should be no bleeding The skin only is sutured.

Plantaris myotomy is suggested as an adjunct to other therapy, either for relief of claudication or venous stasis Often an area in the distal popliteal fossa is tender on moderate pressure Intermittent claudication may be induced by walking only 20-50 ft. Preoperatively stretching of the calf muscles usually gives considerable relief from throbbing and also diminishes edema and adhesive casts applied to both legs, *if both are affected, in overcorrected dorsi*

(2) West. J Surg. 59:317-319 July 1951

flexion of the feet increase the patient's comfort. Indications for plantaris myotomy following active and passive stretching of the posterior leg structures are increase in oscillometric readings (e.g., from 0.25 or 0.5 to 1.0) in cases of claudication, increase in claudication time, and/or for symptomatic relief.

In four patients preoperative treatment gave preliminary

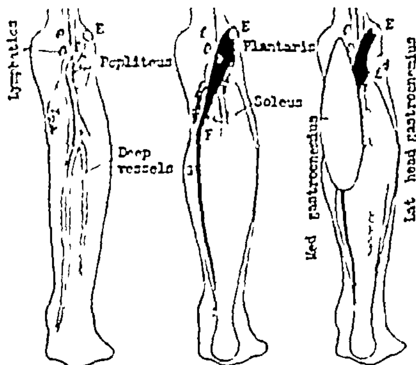


Fig. 100 (left).—Deep vessels running posteriorly to popliteus.
Fig. 101 (center).—Deep vessels squeezed between popliteus and plantaris.
Fig. 102 (right).—Lateral head of gastrocnemius superimposed to plantaris.
(Courtesy of Norman, O. F., and Betts, R. T.: West. J. Surg. 59:317-319, July 1951.)

relief which was made permanent and more complete by operation in three. The fourth was so pleased with the results of active and passive stretchings of the calf muscles that he refused myotomy. In a personal communication, another surgeon told of a patient with idiopathic edema of both legs who had been treated unsuccessfully for a long time; he accidentally ruptured the plantaris, and was cured of his disability.

Management of Varicose Veins of Lower Extremities. Geza de Takats and Edson Fairbrother Fowler[3] (Univ. of

(3) S. Clin. North America 31:1463-1480, October 1951.

Technic.—A clean dissection is made and all tributaries entering the main saphenous trunk are ligated with cotton. The saphenous vein is cut below the saphenofemoral junction, and the proximal end is dissected upward and ligated flush with the femoral vein and transfixed with a suture. Another incision is made on the foot, medial and distal to the internal malleolus exposing the opposite end of the long saphenous vein (Fig 104) The peripheral end is ligated with a fine cotton ligature The small tip of a flexible stripper (Fig 105)

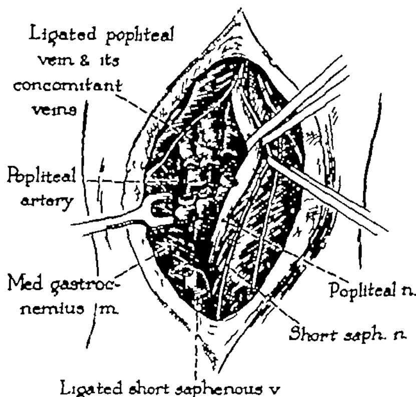


Fig 107—Ligation of popliteal vein. Note short saphenous and popliteal nerves and popliteal artery all of which must be protected from injury The longitudinal incision facilitates exposure. (Courtesy of de Takats, G., and Fowler E. F S. Clin North America 31 1463 1480 October 1951.)

is inserted into the central end and gently advanced toward the groin with motions similar to those used in passage of a ureteral catheter The stripper is ligated in the groin and extraction of the vein is begun. If a branch interferes with stripping a small incision may be made to ligate it. The vein is either inverted or reefed on the stripper and appears in the inguinal incision (Fig 106) If the tip of the stripper gets stuck in the tortuous segments below the knee, an incision is made here, the stripper extracted and the stripping performed from the ankle to this point, the stripper is then reinserted toward the groin. When the stripping is complete cer

tain uncollapsed tortuous collaterals or blow-outs which have no obvious connection with the superficial venous system need to be ligated After skin closure, a pressure dressing is applied Varicosities that remain after this treatment can be injected with sclerosing fluid It may later be necessary to ligate the deep venous system.

If the patient exhibits a marked reflux of blood through a recanalized incompetent deep venous system, it may be necessary to ligate the popliteal vein

TECHNIC.—Using local anesthesia a longitudinal incision is made in the popliteal fossa. The short saphenous vein with the sural (short saphenous) nerve is a guide to the separation of the two gastrocnemius heads The popliteal nerve is treated gently to avoid a traction paralysis. The huge distended or thick fibrous popliteal vein must be carefully separated from the popliteal artery which lies deepest and most medially All veins are doubly ligated with no. 20 cotton, cut and transfixed (Fig 107)

Sclerosing injections still have a place as adjuncts to postoperative treatment to obliterate varicosities which seem not to be fed by the two saphenous systems No more than four injections of 0.5-1 cc of a 5% potassium oleate solution is used

Failure of treatment may result if venous thrombosis has damaged the deep or perforator veins Women with repeated pregnancies may develop increasing backflow through their hypogastric venous systems even though the saphenous system has been obliterated If unligated tributaries remain or the deep venous pressure is high there will be recurrences

Such complications as venous stasis with stasis dermatitis of the leg require the services of a dermatologist and grafting of new skin over a varicose ulcer Sclerosing injections may activate an infection Saphenous ligations may injure the nerve and lymphorrhea and hematoma formation may occur There may be damage to the popliteal or peroneal nerves in popliteal vein ligation.

Modern Trends in Treatment of Varicose Veins are reviewed by Arkell M Vaughn, Cornelius M. Annan and John A. Caserta[4] (Loyola Univ., Chicago) Surgical therapy has, in 25 years, evolved through five phases (1) injection of sclerosing solution, (2) high saphenous ligation, (3) high saphenous ligation with complete resection of veins at the

(4) S. Clin North America 32:287-297, February, 1952.

fossa ovalis, plus injection of a sclerosing solution into the distal vein, (4) high saphenous ligation with multiple retrograde saphenous vein ligation and phlebectomy by means of a malleable intraluminal guide and (5) high saphenous ligation with the vein stripped from groin to ankle and with communicating veins ligated by multiple incisions. The latest method is considered most effective and has been used by the authors in 150 patients since 1948

TECHNIC.—The saphenous vein at its entrance into the femoral vein in the femoral triangle is approached routinely The saphenous vein is freed and divided and dissection continued distally to the medial femoral cutaneous vein which is ligated. Tributaries of the proximal stump of the saphenous vein are dissected, clamped, cut and ligated. Catgut is used. The saphenous vein is then doubly *ligated flush with the femoral vein, excess vein is excised. The* stripper is then inserted down the distal vein. The vein is picked up at an incision above the knee over the tip of the stripper, is cut at the knee and tied over the olive tip of the stripper and then pulled up and removed inside out through the femoral incision Large communicating veins are ligated and divided through separate incisions as resistance is met during stripping Smaller veins may be pulled off without damage. The procedure is repeated first with another incision below the knee, then another at the ankle. The skin is closed with silk and an elastic adhesive bandage applied from foot to groin.

Injection therapy is used as a primary procedure only when there are adequate contraindications to surgery or when the veins are not large enough to warrant surgery Postoperatively, residual veins are injected as needed

Pathogenesis of Varices in Pregnancy According to P Pinlachs, F Vidal Barraquer and J M Biel[5] (Barcelona) such varices have special features They are not limited to the saphenous veins. The dilatations are taut, do not empty easily on elevation of the limb and show local temperature elevation of 1 2 sometimes 3-4 C The distal part may show signs of ischemia, coldness, loss of hair anhidrosis or sometimes, hyperhidrosis and occasionally even ulcers. They may cause no symptoms or may be painful. Frequently arterial pressure at the level of the varices drops and oscillometric readings are lower than on the unaffected limb Venous pressure is increased in the lower limb in both standing and recumbent positions, especially after exercise it is not elevated in pregnant women who have no edema nor varices

(5) Lyon chir 47 263-276 April 1952.

or in nonpregnant patients with varices Trendelenburg test results vary but are frequently normal For these reasons varices in pregnant women are not the result of venous valvular insufficiency but of numerous small arteriovenous fistulas brought on by abnormal opening of neuromyoarterial glomera supposedly caused by action of progesterone and pituitary hormones

In pregnancy, such varices increase in number characteristically in crops They may regress completely or partly after delivery or the fistulas may persist with further development of the syndrome and formation of ulcers In some cases, venous and valvular insufficiency may result and true varices develop

Such conservative measures as pressure bandages are indicated Sclerosing solutions are excellent for obliterating arteriovenous shunts. Injections of histidine with ascorbic acid control pain by producing histamine at tissue level The capillary dilatation that results absorbs blood and diminishes pressure on the glomera

Management of Varicose Veins and Their Related Problems during Pregnancy is considered by Leonard K Stalker[8] (Rochester N Y) Varicose veins have been considered one of the direct results of pregnancy Actually, their development is the result of an inherited tendency and pregnancy is only a single aggravating factor The increased intra abdominal pressure in pregnancy aggravates the incompetency of the superficial venous system. Patients with inconspicuous varices have few symptoms, and the varices usually disappear after pregnancy Treatment should be conservative—rest at regular periods with the feet slightly elevated and use of elastic stockings

Advanced varices should be treated as though pregnancy were not present Division and ligation of both the great and lesser saphenous veins with stripping of the entire great and lesser saphenous systems, can be done up to the seventh month

When superficial thrombophlebitis develops regardless of the state of pregnancy the thrombosed vein should be isolated by at least ligation of the great and lesser saphenous systems If the thrombosis is confined to a small segment of

(8) New York J Med. 62 729 781 Mar 15 1962.

vein, excision of this segment should be done at the time of ligation For deep phlebitis in pregnancy Stalker recommends anticoagulant therapy and paravertebral block. Most patients should be ambulatory and wear compression bandages.

If a small area of indurated cellulitis develops, the stripping operation and complete excision of the area of induration should be carried out. If the area of induration is large, stripping is done and definite surgery for the cellulitis postponed until after pregnancy After any surgical procedure for varices during pregnancy the patient should stay off her feet as much as possible and wear elastic stockings all remaining patent varicosities should be occluded by sclerosis after termination of pregnancy

When superficial thrombophlebitis develops after delivery conservative therapy with anticoagulants is preferred to surgery If varices are first seen during the postpartum period, the patient should be advised to have the condition corrected before further pregnancies

Phlebectomy in Treatment of Acute Thrombosis of Saphenous Varices or Veins According to Louis G Herrmann[7] (Univ of Cincinnati) superficial venous thrombosis is rarely infectious danger results from spread of thrombosis to the deep veins. Anticoagulants do not affect thrombosis which has already taken place to limit its spread, they must be taken for many weeks Expense and difficulty of maintaining required coagulability of blood are considerable

Complete excision of the involved vein with its blood clots (phlebectomy) if done early is simple safe and logical. If delayed until organization of blood clots and cellular reaction around the veins become widespread complete extirpation of veins and blood clots becomes more difficult. During perivenous edema veins can easily be "shelled out" with minimal trauma to surrounding tissues. Phlebectomy should be employed more widely for it reduces disability to a few days, relieves pain promptly reduces cost of illness and eliminates the rare more serious complications after superficial venous thrombosis.

Woman, 46, had thrombosis of large varices in the right thigh and lower leg She had had varicose veins from right groin to mid

(7) A.M.A. Arch. Surg 64:681-685 May 1952.

leg for 20 years but they were not seriously troublesome until one week before hospitalization Soon after an elastic stocking was applied inflammation spread up into the varices above the elastic stocking. She had fever but no chills. The peripheral veins had not previously been inflamed Despite local hot-cold treatment inflammation spread to the midthigh A firm mass 4 cm. in diameter and 8 cm long was palpable in the right midthigh The skin over it was edematous red and tender The tortuous and dilated saphenous vein distal to this point was filled with a firm blood clot and tender to light palpation Peripheral arterial circulation was normal

Penicillin, 400,000 unit , but no anticoagulants was given The next morning the saphenous and femoral veins were exposed. The great saphenous vein was enlarged and its upper valves incompetent. It was ligated clo e to the femoral vein the entire saphenous vein and its enclo ed blood clot were removed by sharp dis ection through multiple "buttonhole" incisions all tributaries or perforating veins were ligated. Po toperative course was uneventful. She was permitted out of bed the day after operation and to walk within two days. Total disability after operation was three days Phlebitis did not recur

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ESOPHAGUS

Esophageal Hiatus Hernia of Diaphragm Anatomic Characteristics, Technic of Repair and Results of Treatment in 111 Consecutive Cases. According to Richard H Sweet[8] (Boston) the anatomic types are sliding (formerly termed short esophagus) and parahiatal (formerly termed paraesophageal) Shortening of the esophagus though suspected by x ray in 87 patients was actually present in only 4 i e., it could not be elongated sufficiently to place the cardia beneath the diaphragm The term paraesophageal is now regarded as inaccurate The sliding type of hiatus hernia being one in which one wall of the peritoneal sac consists of an abdominal viscus has the anterior wall of the stomach for the posterior portion of the hernial sac (Fig 108), the anterior and lateral surfaces of the sac represent upward pouching of peritoneum In the parahiatal type the cardia remains below the diaphragm the hernia ascending into the mediastinum to one side of the esophagus while a small strand of tissue from the edge of the esophageal hiatus remains undisturbed by the herniation (Fig 109) In addition,

(8) Ann. Surg 135 1 13 January 1952

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(8) Ann. Surg 135 1 13 January 1952

there are infrequent variants of these two types (1) congenitally short esophagus with thoracic stomach, which is readily demonstrated at operation, (2) double hernia, or composite type, which is actually a combination of both the sliding hiatal and parahiatal

Of the 111 patients, 87 4% had the sliding type, 6.3% the *parahiatal*, 4 5% congenitally short esophagus with thoracic stomach and only 1 8% the composite type There was considerable overlapping of symptoms presented by the patients. They were distress other than pain (e g, heartburn or

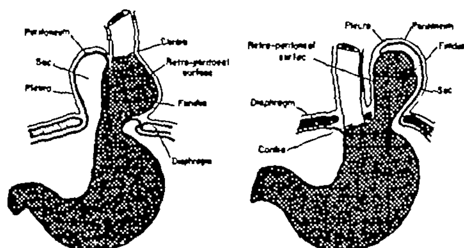


Fig 108 (left) —Sliding type of hiatus hernia. Drawing is made as of a sagittal section through area involved to show relation of herniated portion of stomach to hernia sac.
Fig 109 (right) —Parahiatal type
(Courtesy of Sweet, R. H Ann. Surg 135 1 13 January 1952)

bloating) in 34% intractable pain in 35% blood loss in 19% and obstruction in 12% All had symptoms of such severity or long duration that they sought surgical relief The repair technic follows

TECHNIC.—Under intratracheal inhalation anesthesia a long oblique incision is made on the left side, resecting the eighth rib. The left lung is retracted, adhesions are divided as required and the phrenic nerve is crushed. The mediastinal pleura overlying the hernia is incised longitudinally and severed from its attachments around the margin of the esophageal hiatus. This exposes the hernial sac, herniated stomach and lower end of the esophagus, and mobilizes the vagus nerves. The hernial sac is eliminated by (1) plication of the sac, thereby inverting it into the abdomen (though avoiding the wall of the stomach in the sliding variety) and/or (2) excision of the redundant portion of the sac after replacement of the viscera

below the diaphragm or if difficulty is encountered after making a short counterincision through the peripheral portion of the diaphragm in the direction of its fibers through which the stomach and other viscera are drawn down into the abdomen. Peritoneal edges are approximated with interrupted silk mattress sutures. Heavy silk sutures are placed in the diaphragmatic muscle on either side of the esophagus to reduce the size of the aperture to just that which permits the index finger to be inserted comfortably through the posterior portion of the hiatus with a Levin tube in the esophagus. Occasionally fragile diaphragmatic tissues must be reinforced with strips of fascia lata. The mediastinal pleura is sutured together and reattached to the diaphragm near the hiatus. After the lung has been re-expanded, a catheter is inserted through a short incision in the ninth or tenth intercostal space. Closed drainage is provided by a water seal or controlled suction with a valvular release.

Of the 111 patients, 79 were successfully dealt with by plication alone, 18 required excision from above the diaphragm and 10 required removal of the sac from beneath through a counterincision in the diaphragm. In four patients with congenitally short esophagus and thoracic stomach incomplete repair was done since it was impossible to bring the cardiac end of the stomach down below the diaphragm. Vagotomy was done in some patients either because of special indications or because it was technically necessary. Abdominal exploration was done in eight through a counter incision.

There were no postoperative deaths. Of 108 patients followed six or more months, 87% (94 patients, including all with bleeding or obstruction and all with parahiatal hernia) had complete relief from symptoms. Ten patients (1 of whom was later found to have cancer of the pancreas also) had partial relief and 1 no relief. Two patients had recurrence of the hernia, one of whom had been originally operated on as an emergency case because of incarceration and gastric obstruction.

Complications and Surgical Treatment of Hiatus Hernia and Short Esophagus with Thoracic Stomach. Donald B. Effler and E. N. Collins[9] (Cleveland Clinic) point out that careful distinction must be made between symptoms and complications in evaluation of the extent of the disease and its response to conservative therapy. Most patients with acquired short esophagus have dyspepsia, esophageal pain,

(9) J. A. M. A. 147: 304-308, Sept. 2, 1951.

dysphagia, nocturnal distress and retrosternal discomfort. Bleeding is the commonest complication and is usually occult. Periodic, severe hematemesis does occur. Peptic ulcer may occur as either the initiating factor or as a secondary complication. When ulcer is present there are associated esophagitis and gastritis which greatly impede accurate

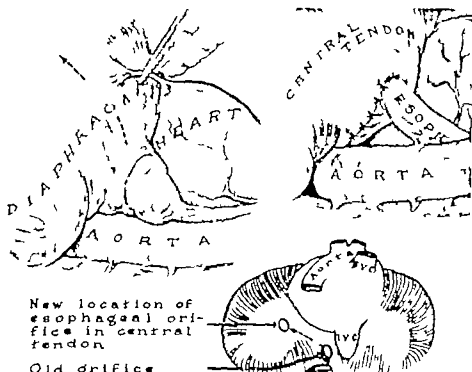


Fig 110.—Anatomic features as viewed through thoracotomy incision during operation for structurally uncomplicated short esophagus with thoracic stomach. (Courtesy of Effler, D. B., and Collins, E. N. J. A. M. A. 147 305-308 Sept. 22 1951.)

localization. In patients operated on for ulcer the ulcer has always been in the thoracic stomach.

Dysphagia is the commonest symptom of short esophagus and is usually due to an organic stricture as a result of a severe inflammatory process such as long-standing esophagitis. The stricture is due to a cicatrizing contracture at the cardiac end of the esophagus. There may be associated progressive shortening which is believed due to a reflex phenomenon with inflammatory and neurogenic factors.

Careful medical therapy and periodic use of bougies often will alleviate the symptoms of short esophagus but cannot

cure the structural abnormality When there are associated complications evaluation of the primary disease is difficult Surgical treatment involves transthoracic resection of the diseased esophagus and cardia with esophagogastrostomy The long standing inflammatory process produces a severe reaction in the mediastinum rendering dissection considerably more tedious than is usual for esophageal tumor Anemia, malnutrition and chronic disease increase the risk of surgery This operation was performed on six patients, all of whom were benefited Although relief from ulcer pain stricture and bleeding was obtained it was necessary for the patients to continue on a prolonged medical regimen

A simple operation has been devised for an uncomplicated short esophagus It consists of transthoracic reduction of the stomach, with alteration in the diaphragmatic hiatus and phrenic paralysis (Fig 110) Although the esophagus itself is not appreciably lengthened, the vertical diameter of the thoracic cavity is shortened

TECHNIC.—Thoracotomy is performed at the level of the eighth left rib and the pulmonary ligament divided The terminal esophagus and thoracic stomach are completely mobilized from within the mediastinum. The phrenic nerve is crushed A site is selected for the new hiatus and the diaphragm is incised from this point through the anatomic hiatus The stomach is carefully freed from its posterior and medial attachments along the crura of the diaphragm. The terminal esophagus and thoracic stomach are completely mobilized with separation of the mediastinal and subdiaphragmatic attachments.

The cardia of the stomach is brought laterally to the site of the new hiatus the right and left crura are approximated with interrupted silk sutures, with resultant obliteration of the original hiatus medially and posteriorly to the cardia. The stomach is reduced below the diaphragm, and the tendinous portion is closed around the cardiac esophagus. When the repair is finished, the cardiac stomach is at the highest point under the dome of the diaphragm.

[Hernia in this location has potentially dangerous complications, as does hernia elsewhere. For that reason, unless there are special contraindications to an operation, the hernia should be repaired. In competent hands the risk of the operation is negligible.—Ed.]

Massive Hematemesis from Hiatus Hernia. Lemuel Bowden and Charles J Miller[1] (Memorial Hosp, New York City) report the occurrence of this complication in three patients during convalescence from completely unrelated surgical procedures and in one 28 months after an operation for an

(1) A.M.A. Arch. Surg. 63 143 146 August, 1951

unrelated gastrointestinal lesion Of the three who had recently been operated on, one had a tracheostomy and a hacking cough and two had frequent oral and tracheal aspirations postoperatively The fourth had a heavy chest cold, characterized by paroxysms of coughing The exaggerated motions and periods of temporary spasm of the diaphragm secondary to coughing, oral suction or tracheal aspirations appear to have been the causative factors in these cases. The spasm and contractions of the diaphragm may well have accounted for at least temporary incarceration of the herniated portion of the stomach, which under normal circumstances slides back and forth from the abdominal into the thoracic cavity This temporary incarceration causes vascular engorgement, with subsequent mucosal necrosis and ulceration, leading to massive hemorrhage An additional factor may be the action of retained acid gastric secretions in the incarcerated gastric pouch above the diaphragm.

Interruption of the phrenic nerve impulses to the left side of the diaphragm, although not tried in the series, may be a physiologic approach to correction of the underlying factors When diagnosis is known, and if the presence of an associated gastric neoplasm or ulcer can be excluded, phrenic nerve interruption may be a necessary adjuvant to the customary measures of sedation and blood replacement therapy

Epiphrenic Diverticulum of Esophagus is discussed by Harvey W Kausel and Gustaf E Lindskog[2] (Yale Univ) The etiology is unknown, although less than half the reported cases have been associated with cardiospasm There is as much evidence for as against the condition's being secondary to cardiospasm Some cases are associated with hiatus hernia or short esophagus and may be caused by congenital weakness of the muscle layers or herniation through weak areas surrounding the nutrient vessels.

Diagnosis is usually not difficult Though mild dyspepsia may be the sole symptom dysphagia, epigastric or substernal pain, regurgitation eructation and even vomiting after meals in conjunction with anorexia and weight loss are characteristic Esophagoscopy and barium studies will demonstrate the lesion.

Asymptomatic lesions are best left untreated If an asso-

( ) Dis. Chest 21:334 345 March, 1952.

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(2) Dis Chest 21 334 345 March, 195_

types of surgery have been considered for cardiospasm that fails to respond to dilatation. Esophagogastrostomy with three-quarter *subtotal gastric resection would prophylactically* protect the distal esophagus against acid pepsin by reducing the acid bearing portion of the stomach and shortening emptying time This operation, done once, gave considerable improvement in symptoms. Heller's cardiomyotomy may prove to be the operation of choice in cardiospasm. It is simple and is similar to the Ramstedt procedure for pyloric stenosis The musculature of the narrowed area is cut and spread, allowing the mucosa to bulge through. This procedure has been performed once, with good immediate postoperative results.

[The operations described by the authors are practically always unsatisfactory and should be regarded as obsolete. In most cases the simple Heller procedure gives excellent results.—Ed.]

Physiologic Operation for Megaesophagus Dystonia, Cardiospasm, Achalasia Owen H Wangensteen[4] (Univ of Minnesota) states that megaesophagus is believed due to absence of Auerbach's plexus of nerve cells in the esophageal wall, being analogous to megacolon and hypertrophic pyloric stenosis. The term dystonia is preferred for the condition since it indicates the combination of hypertonus of the distal segment, known as cardiospasm, and atony of the proximal segment of the unstriated musculature of the distal two thirds of the esophagus, known as achalasia. Since idiopathic esophageal stricture is a manifestation of acid peptic ulcer due to regurgitation of gastric acid peptic juice, operation for its correction must take into consideration the effects of gastric acid peptic juice on the esophagus, even though dystonia is not an acid peptic linked disorder Failure of cardiospasm to respond satisfactorily to conservative dilation is an indication for surgery Wangensteen's procedure involves excision of the dilated atonic, unstriated segment of the esophagus excision of the acid-secreting area of the stomach, and pylorotomy (not pyloroplasty) to ensure emptying of the vagotomized residual antrum.

TECHNIC.—Anesthesia is induced with pentothal® and curare and maintained with ether A midline upper abdominal incision is made accompanied by median extrapleural sternotomy extending into the fourth intercostal space (Fig 111*A*) The avascular ligament of the

(4) Ann Surg. 134 301 318 September 1951

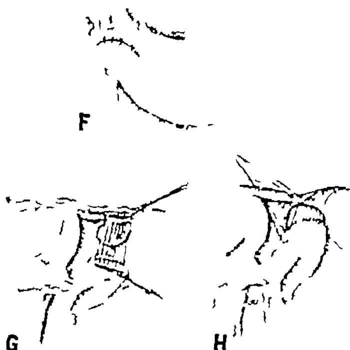


Fig 112 —Operation for esophageal dystonia (cont) (Courtesy of Wangensteen O H : Ann. Surg 134 301-318 September 1951)

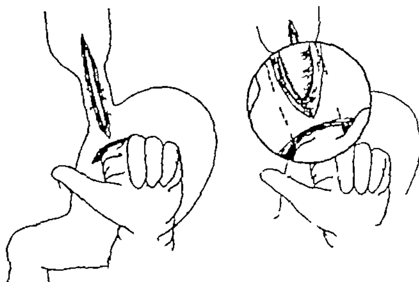


Fig 113 —Heller myotomy under digital and visceral control. On right, field in circle indicates use of magnifying glass in final division of circular muscle fibers in esophageal wall. (Courtesy of Wangensteen, O. H. Ann. Surg 134 301-318 September 1951)

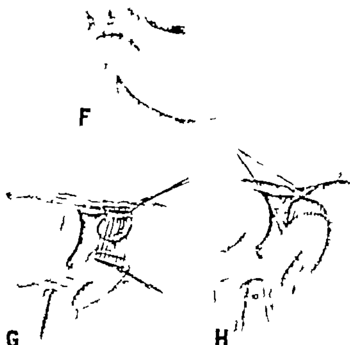


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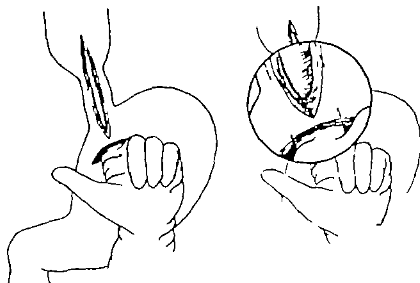


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below the diaphragm) The sternum is coapted with no 24 steel wires through drill holes and closure effected.

The seven patients operated on had relief from dysphagia though two had to have occasional postoperative dilation Food was no longer regurgitated and size of the esophagus shrank in all patients Apart from Heller's extramucosal myotomy operation (Fig 113), which corrects cardiospasm by its long 8 12 cm incision but not the megaesophagus it self previous operative procedures have proved unsatisfac tory chiefly because they invited esophagitis from acid peptic regurgitation

Pathologic Changes in Megaesophagus (Esophageal Dystonia) Frederick S Cross[5] (Univ of Minnesota Hosp) pre sents data on seven surgical cases of megaesophagus and two seen at autopsy Surgery consisted of resecting the lower portion of the esophagus with the acid secreting por tion of the stomach The tortuous esophagus was then freed as much as possible and straightened out by drawing it down and anastomosing it to the antral portion of the stomach. Patients were aged 24-76 and duration of symp toms ranged from 1½ to 30 years. Earliest age of onset was 10 and latest 74 Sections from nine esophagi without megaesophagus, from patients aged 45 80, were also studied to establish the normal appearance These specimens were obtained at surgery and autopsy

There was an inflammatory reaction throughout the eso phageal wall which was both acute and chronic much of the acute phase in the surgical specimen being due to operative trauma Chronic inflammatory change with infiltration of lymphocytes was most severe in the serosal and submucosal layers The mucosa was intact in all specimens The layer of Auerbach's plexus was usually wider than normal, with mononuclear and polymorphonuclear cell infiltration and an increase in capillaries The fibrous tissue reaction varied from a slight increase to complete replacement of the plexus in some areas by dense fibrous tissue Many of the ganglions were almost completely replaced by small mononuclear cells resembling lymphocytes. There was also an increase in the interstitial connective tissue in the ganglions. There was evidence that loss of ganglion cells is limited to the esoph

(5) Surgery 31:647-653 May 1952

agus One of the esophagi obtained at autopsy differed from the others in that ganglion cells were found in significant numbers, although not as frequently as in a normal esophagus. In this case symptoms had been present for only 1¼ years, whereas in the others they were of 12-30 years' duration The fact that no ganglion cells were found at any level in an esophagus of which 14 cm was available for study indicates that in the late stages of the disease ganglion cells are destroyed in the entire length of the organ.

Loss of ganglion cells from the esophagus is accepted as the etiologic basis of esophageal dystonia by some investigators, however, physiologic functional changes in an organ cannot be explained by investigating pathologic changes alone Loss of ganglion cells may be a secondary rather than the primary cause of the disease In this study destruction of ganglion cells is explained on the basis of a neurocytolysis of the nerve cells by proliferating capsular cells Further investigation is needed to determine the true etiology of the disease

Carcinoma of Esophagus Edward F Parker, Charles B. Hanna and Raymond W Postlethwait[6] report data on 170 hospital and clinic patients with histologically proved epidermoid carcinoma of the esophagus, 86% of whom were Negroes. Ninety six per cent of the patients were from the lower economic strata. Duration of symptoms varied from three weeks to one year in most patients, but 17 7% had symptoms for three weeks or less. Dysphagia was the commonest symptom as well as the commonest first symptom Weight loss was experienced by a high percentage, whereas pain regurgitation, cough and hoarseness were encountered less often The reason for late diagnosis was misinterpretation of symptoms by the physician rather than neglect by the patient

Of the 170 patients 114 were inoperable Of the 56 operable patients, 26 had nonresectable and 30 resectable lesions Palliative resections were performed on 24 and theoretically curative resections on 6 Average survival time from onset of symptoms to death was 7.5 months for the untreated patients and 9 8 months for those treated by gastrostomy alone Survival times for patients who under

(6) Ann. Surg. 135 69 705 May 1952

went exploration, with or without gastrostomy, and were found to have nonresectable lesions were roughly the same as for the other groups

Operative mortality was 54% (13 deaths) for the 24 patients having palliative resections and 66% (4 deaths) for the 6 having theoretically curative resections Of the nine patients having palliative resection and esophagogastrostomy, eight died in an average of seven months after operation and were significantly improved for an average of five months The other patient was still alive 10 months after operation and had maintained weight and strength One patient treated by palliative resection and end to-end anastomosis lived 9 months after operation and another treated by palliative resection and a Thorek operation lived 10 months Of the two surviving curative resections, one lived for 12 months and the other was still living 3 years after operation with normal swallowing no complaints and no evidence of recurrence

These figures illustrate that the results of surgical therapy fall short of desired levels and that further improvement should be sought in other methods of therapy

Carcinoma of Esophagus or Cardia of Stomach Analysis of 172 Cases with 81 Resections Y K. Wu and H H Loucks[7] (Peking Union Med. College) observed these cases over 3½ years among persons living in North China The rough and irritant character of the food (millet, maize and kaoliang) and drink of the northern Chinese, and the possible presence of carcinogenic substances in kaoliang, may be causative factors in the unusually high incidence of this disease in North China. Fifty per cent of the patients, as compared with 12% in a control group were habitual consumers of a strong distillate of kaoliang Most patients belonged to the lower economic level thus, their food tended to be rough and bulky A positive family history of esophageal cancer was given by 22.1%

Of 12 patients who underwent resection in 1940-41 2 showed five year cures Exploration was done in 74 7% of the patients. Resectability rate calculated on the basis of the total number of patients and on the number operated on, was 47 1 and 63% respectively These rates compare

(7) Ann. Surg 134 946 956 December 1951

favorably with those for carcinoma of the lung and stomach The lower the site of the tumor, the higher the resectability rate probably because vital organs are not invaded as early Resectability in patients under 40 was less than that in older ones Operative mortality rate was 17.3%, reduced more recently to 7 7% Of the 67 patients who survived resection, 41 were alive a few months to over three years after operation.

When the gross tumor cannot be excised completely, palliative resection is not justified Only 5 of 91 nonresectable patients survived over six months Calculated from onset of symptoms and from time of hospital discharge average duration of life was 8 8 and 2.2 months respectively Palliative gastrostomy or jejunostomy did not prolong the survival period

Early diagnosis appears to be important in resectability the nonresectable patients having had symptoms an average of two or more months It should be feasible through (1) education of the layman with regard to the possibilities of survival after early diagnosis and resection (2) thorough investigation at initiation of choking on food or transient dysphagia, reliance not being placed on the late symptoms of dysphagia and cachexia which appear after the tumor has completely encircled the esophagus (3) careful x ray examination of the esophagus (it should be remembered *that until more than half the lumen is involved* barium readily passes through the esophagus, and that a filling defect may have to be viewed from different angles), (4) direct observation by esophagoscopy in clinically suspected cases In view of the high incidence of esophageal carcinoma among males (ratio 13 1) any swallowing disturbance in a man over 35 should be considered esophageal carcinoma until proved otherwise

[There is considerable disagreement about the wisdom of a palliative resection. Many patients are much happier if enough of the involved esophagus is removed to permit swallowing. That is the only justification for a palliative resection.—Ed.]

Palliative Gastrostomy for Inoperable Carcinoma of Esophagus J C Dickison[8] (Montreal Gen'l Hosp) reviewed the hospital records for 1935-48 There were 103 patients with esophageal carcinoma 55 of whom had palliative gas

(8) Canad. M A. J 65 35-40 July 1951

trostomy Of these, 21 (42%) died in the hospital after an average survival of 21 days Of those that left the hospital alive, 27 were traced they had an average survival of 202.6 days (Fig 114) Average survival for the 50 patients traced was 120 days No particular type of gastrostomy seemed to have any advantage over the others Among 23 patients who were not operated on average survival was 111 days In other words 50 patients were exposed by palliative operation to a 42% hospital mortality risk, plus painful wound and dressings, skin excoriation, and/or wound infection to add nine days to their survival time

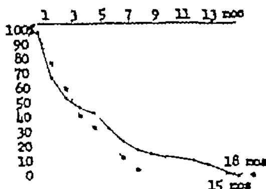


Fig 114 —Solid line per cent of survival in 50 patients who underwent gastrostomy Broken line per cent of survival in 23 patients who did not undergo gastrostomy (Courtesy of Dickison, J C Canad. M A J 65 33-34 July 1951)

The longest average survival 126 days, was in a group of seven patients who refused gastrostomy

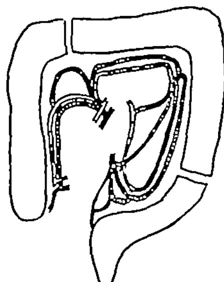
Some authors state that gastrostomy is indicated only when fluids cannot be taken orally Dickison, however concluded that "when fluids by mouth cannot be tolerated the blessed end is near enough without direct assistance"

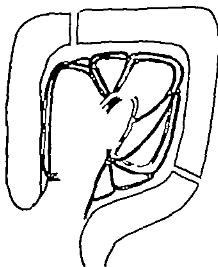
Esophagoplasties by Means of Transverse and Descending Colon are discussed by Paul Orsoni and Marcel Lemaire[9] (Paris) Use of the colon presents definite advantages because of facility of mobilization excellent vascularization and relatively small caliber

TECHNIC.—The loop is prepared by mobilizing the transverse and descending sections, after which the vessels are divided in accordance with the existing pattern (Figs. 115-117) Usually this may be done by (1) ligating the artery and vein of the splenic flexure after which the avascular mesocolon is divided and the left border of the

(9) J chir 67:491-505 June-July 1951

pedicle defined, (2) dividing the vascular arcade of the descending colon, section starting proximal to the end of the artery and extending to the splenic flexure, and (3) dividing the arcade to the right, beyond the termination of the left branch of the right colic artery The ends of the loop are then divided, the resected colon is anas-





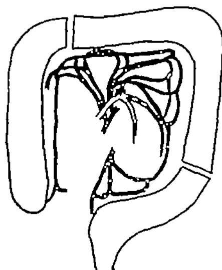


Fig 115 (above left) —After angiography on fresh cadaver Schematic distribution of blood vessels.

Fig. 116 (above) —Large middle colic artery

Fig. 117 (left) —Left and middle colic arteries arising from superior mesenterie. Inferior mesenteric vein drains into superior mesenteric.

(Courtesy of Orsoni, P., and Lemaire M. J chir 67 491-505 June-July 1951)

omosed end to end, a 'precolic" side-to-side anastomosis of the ›wer end of the loop to the ileum is carried out (Fig 118) and the pper end is closed with inverting sutures. The cervical esophagus ; then exposed and mobilized in the neck. Unless thoracic exploraion with or without excision of the tumor has already produced a ervical esophageal stump, excision of the tumor is best accomplished

by bringing it up into the neck, as the cervical stump has a strong tendency to retract, resection is done as low as possible The lower end of the esophagus is closed, the colon brought up into the neck by one of various methods and an end to side anastomosis made

The anterior intrathoracic, substernal location of the loop seems to offer the greatest possibilities in esophageal cancer, whether purely palliative or in preparation for ablation of the tumor and especially in benign strictures. The esophagus is first resected in the neck the colic loop prepared, xyphoid resected and an extrapleural tunnel created by

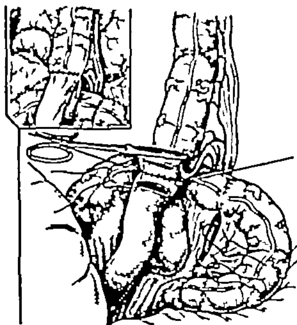


Fig 118 —Coleileal anastomosis. (Courtesy of Orsoni, P., and Lemaire M. J chir 67 491-405 June-July 1951)

gradually working up one and then finally four fingers which are kept close to the posterior surface of the sternum without separating the mediastinal pleuras (Figs. 119 121) A presternal subcutaneous tunnel is less desirable When a high thoracic esophageal tumor has been approached through either the right or left side, the loop may be placed in the posterior mediastinum. During thoracotomy the esophagus is divided below the tumor and the two ends connected with a long string At the abdominal preparation the lower stump is drawn into the abdomen, the string attached to the upper part of the colic loop and the esophageal hiatus in

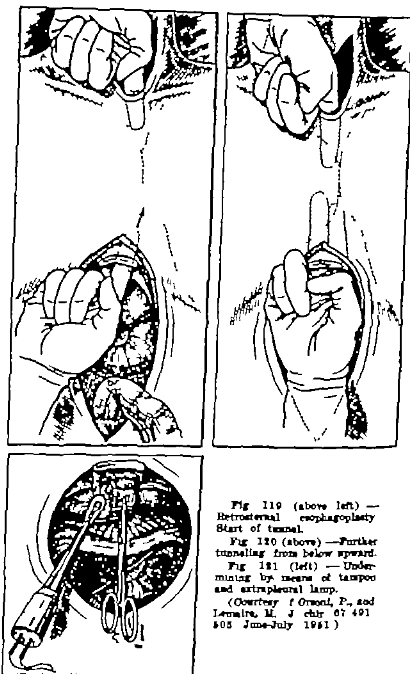


Fig 119 (above left) — Retrosternal esophagoplasty Start of tunnel.

Fig 120 (above) — Further tunneling from below upward.

Fig 121 (left) — Undermining by means of tampon and extrapleural lamp.

(Courtesy f *Orsoni, P.*, and Lemaire, M. J chir 67 491 505 June-July 1951)

the diaphragm enlarged. The upper part of the esophagus and the tumor are then excised and the colic loop is brought up by *means of the string and anastomosed to* the upper esophageal stump Resection is done above the lesion if it is inoperable and only the upper part of the esophagus is

mobilized and brought up into the neck, the lower end of the string is brought through the hiatus during the thoracic stage With the left approach a combined thoracoabdominal procedure allows resection of the esophagus and preparation of the colic tube in one stage

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ABDOMEN—GENERAL

Abdominal Masses I. Survey of Incidence and Clinical Significance is made in 5 000 consecutive unselected patients excluding children and pregnant women, by Donald B Butler and J Arnold Bargen[2] (Mayo Clinic) Largely the group represents patients referred because of serious or unusual diseases In 215 241 abdominal masses were palpated About one third had a malignant mass, which stresses need of prompt diagnosis particularly if the mass is enlarging More than half the masses were in the hypochondriac regions with over a third in the right hypochondrium about two-thirds were in the upper abdomen There were more than twice as many masses in the right side of the abdomen as in the left one third of them being liver

Of masses felt in the right hypochondrium 88 6% were liver in the left hypochondrium 83 3% were spleen 42 8% of the epigastric masses were stomach, and 19% were ventral hernias Three fourths of the patients were unaware of the masses Pain was the presenting complaint in 53 7% of the malignant group and in 33 1% of the benign group Benign masses tended to be round or oval smooth and smaller than malignant masses, while mobility and hardness were equivocal as to malignancy and benignancy Half of the malignant masses were primary with some chance of surgical cure

Surgery in 101 patients disclosed malignancy in 74 3% The malignant group was on the average over 10 years older than the benign group

Factors affecting palpation of an abdominal mass are (1) size of mass, (2) relation to anterior abdominal wall (including presence of adhesions) (3) relaxation of ab-

(2) Gastroenterology 19 1 12, September 1951

dominal wall. Size is difficult to alter unless a hollow viscus becomes distended (or is distended through a stomach tube) The relation of mass to anterior abdominal wall can be *altered by positioning* the patient (e g., knee chest position) or by pressing the mass forward with a hand against the posterior abdominal wall Relaxation may be increased by sedation or by so positioning the patient as to relax the rectus muscles. Gentleness and warm hands may spell success in palpating an abdominal mass

Enterocystomas Report of Six Cases and a review of the literature *are presented by Kai Dohn and Olaf Povlsen*[3] (Copenhagen) Most enterocystomas occur in the alimentary tract and appear along its entire course, although their site of predilection is the terminal ileum (136 of 315 cases), most intestinal cystomas are embedded in the intestinal wall itself, mainly in the subserosa or muscularis and often in the submucosa Some are situated outside the intestinal wall *between layers of mesentery, a few float in the peritoneal* cavity attached by a stalk or an independent mesentery to the intestine About three fourths of intestinal cystomas are mesenteric. Almost all thoracic types originate from the posterior mediastinum. About one-fourth are minor cysts near or in the esophageal wall The others extend into the hemithorax (two-thirds into the right) and, exceptionally, may prolong through the diaphragm. Most often they adhere to the esophagus, some with a common muscular wall, about one fourth lack any connection with the esophagus They may adhere to the lung trachea, aorta, pericardium and diaphragm or erode the spine and *ribs, in* several instances they have given rise to scoliosis They ordinarily range from plum to orange size and sometimes fill most of the abdomen. The cysts are unilocular with few exceptions, and generally round or ovoid, but all transitional forms are found to be typical tubular intestinal duplications.

The wall ordinarily consists *of the same* layers as that of the alimentary tract. The mucosa is well developed with characteristic epithelium and often with typical glandular elements The muscular coat generally is formed of two thick layers and *often* shows *ganglion cells and nerve*

(3) Acta chir scandinav 102 21-35 1951

fibers Submucosal FCs have no independent muscular coat Mucosa of 80% of abdominal enterocystomas is like that of the adjacent part of the alimentary tract, in the rest it corresponds to that of some other part Those in the thorax are seldom lined by stratified squamous epithelium Esophageal or periesophageal forms are lined by cylindric ciliated epithelium, as the respiratory tract and fetal esophagus. Malignant degeneration is exceptional

About 85% of thoracic enterocystomas cause symptoms, 40% occur in the first year of life, 30% after 16 and only 6% after 50 Abdominal cysts without symptoms are generally discovered at autopsy, most often in stillborns or newborns a few are found on clinical examination About two thirds of the symptom producing intra abdominal type cause ileus generally by intestinal compression, but may also form the point of origin of intussusception or volvulus Simple pressure necrosis of the intestinal wall may cause peritonitis A mass is sometimes the only symptom Diagnostically the most important sign is palpable mass Surgical removal must always be the goal because serious complications eventually appear Besides risk of opening the alimentary tract excision of intramesenteric cyst may interfere with the intestinal blood supply, so resection of the alimentary tract connected with the cyst should be preferred However 40 patients were treated by enucleation without death. Marsupialization should be used only when no other method is possible

Clinically the thoracic type is nearly always chronic becoming manifest after birth in half the cases Symptoms arise from pressure of the expanding cyst on lung and respiratory tract. Accordingly predominant symptoms are cough, expectoration dyspnea, stridor and often fever, due to atelectasis. The dyspnea is frequently attended by cyanosis and sometimes occurs in paroxysms. Signs of compression of mediastinal structures are rare Hemoptysis due to penetration of peptic ulcer in a gastrogenic cyst into the lung is a serious complication Roentgenologically a thoracic cyst most often appears as typical mediastinal tumor often it is less obvious Except for minor esophageal cysts thoracic cyst is as dangerous as an intra abdominal one Symptoms occur earlier Many can be successfully excised transpleural

ly in one stage If the cyst adheres to the neighboring organs, especially the esophagus, these may be damaged However, 10 patients (of 25 operated on) were treated by primary excision, without opening the esophagus, all recovered

[Some cysts attached to the esophagus are accessory stomachs showing typical gastric mucous membranes.—Ed.]

Mesenteric Cysts, Enterocystomas and Omental Cysts are discussed by S.J G Rinsma[4] (State Univ of Groningen) These cysts with retroperitoneal cysts, form one group both as to structure and place of origin. Organs originally intramesenteric become retroperitoneal during fetal life, and conversely cysts originally retroperitoneal may become mesenteric by development between the layers of the mesentery

Among the genuine cysts, classified according to Henschen, are cavernous and cystic lymphangiomas (lymphatic cysts) Their wall contains dilated lymph vessels, lymphoid tissue and occasionally smooth muscular fibers, and the cyst contents are of a serous, chylous or pulpy character Included in this classification are enterocystomas congenital cysts arising in the gastrointestinal tract. Their contents may be mucous, colorless or yellow to brown, hemorrhagic chylous or pulpy Other genuine cysts are those originating from remnants of the wolffian duct, müllerian duct, ovaries or germinal epithelium cysts arising from endometriomas (chocolate cysts), simple dermoid cysts originating from discarded ectodermal germ plasm, and parasitic cysts, including those due to echinococcus and Cysticercus cellulosae Pseudocysts include gas cysts which occur in conjunction with gastric or duodenal ulcer as a result of gas penetration through the ulcer or via minute mucosal fissures and tend to spontaneous resolution blood cysts due to hematoma softened cyst arising from a caseated lymph gland, butter cyst, arising from a degenerated lipoma, and hydrops cysticus omenti, i.e accumulation of fluid between the omental layers

The clinical symptoms vary greatly depending on site and size of the cysts. Fairly large ones may be asymptomatic others may cause pain constipation or diarrhea.

(4) Arch chir neerl. 3 139 160 1951

Intestinal obstruction occurs in about 50% of cases. Again the cysts may become complicated by hemorrhage, rupture, infection or malignant degeneration. Enterocystomas may be painful due to contraction of the smooth muscles in the cyst wall. Torsion of the cyst pedicle is also possible.

Suspicion of a cyst is warranted when a round tumor feeling like a cyst is movable in a transverse direction in the abdomen. Sometimes, however, a cyst has a short mesentery and is not movable. When calcification of the cyst wall or of the cyst contents is present, it can be demonstrated by x-ray. Urograms and gastrointestinal x-rays may also yield useful data pointing to the presence of a cyst.

Treatment is surgical and consists of (1) enucleation of the cyst when feasible, (2) resection of the corresponding portion of the intestine and mesentery, or (3) marsupialization, when enucleation is impossible or resection too formidable. The drawbacks of marsupialization are that a fistula will remain, thus prolonging the illness, or that the scar will rupture with the possibility of recurrence.

Of 10 cases seen by Rinsma, enucleation was done in 5 and resection of the intestine in 5. There were six lymph cysts, chyle cysts or lymphangioma cavernosum, one enterocystoma, one mesenteric cyst of unknown origin, one old subserous hemorrhage and one omental cyst.

Lymphopenia in Diagnosis of the Acute Abdomen. Albert E. Hirst, Jr., and Varner J. Johns, Jr.[5] (College of Medical Evangelists) studied the white blood cell counts of patients with a variety of verified acute conditions. Counts were made before any definitive therapy was attempted. Diagnosis of pancreatitis was made at operation, autopsy or clinically on the basis of an elevated serum amylase level. All diagnoses of cholecystitis, acute and chronic, were histologically proved. Patients with myocardial infarction had typical clinical symptoms and confirmatory ECG changes. Patients with second and third degree burns were accepted for study if at least 10% of the body surface was involved, and those with first degree burns, if more extensive lesions were present.

Lymphopenia is expressed as absolute or relative. The former refers to a decrease in the total number of lympho-

(5) Am. J. M. Sc. 223:548-553, May, 1952.

cytes per cubic millimeter of blood and the latter to a decrease in the percentage of lymphocytes in the total white cell count. The relative lymphocyte count is arbitrarily expressed as below 20, 15 or 10% of the total white cells found in the acute conditions studied The absolute lymphocyte count is expressed in values below 1,500 and 1 000/cu mm. A relative lymphopenia below 20% was found in 86% of the patients with acute pancreatitis, the incidence was comparable in patients with perforated duodenal ulcer dissecting aneurysm, acute appendicitis and acute cholecystitis A relative lymphopenia below 10% was present in 55% of the patients with pancreatitis, 42% with acute appendicitis and 40% with perforated duodenal ulcer An absolute lymphopenia below 1,500 cells was found in 63% of the patients with acute pancreatitis, 75% with dissecting aneurysm and 64% with intestinal obstruction Depressions of lymphocytes below 1,000 were found in 26% of the patients with acute appendicitis and pancreatitis and in 25% of those with dissecting aneurysm.

Absolute and relative lymphopenia occurs in a variety of acute conditions but is not diagnostic Evidence suggests that the depression of lymphocytes in acute conditions is selective occurring independently of the polymorphonuclear leukocyte count. The degree of absolute lymphopenia was proportional to the severity of the invoking stress It follows that lymphopenia is an unfavorable sign in the leukocytic picture Conversely a return of the lymphocyte count toward normal suggests a good prognosis.

[For many years it has been realized that the number of lymphocytes afforded a good idea of the development of resistance in a patient with tuberculosis. In my own experience I have found it unwise to operate on a tuberculous patient with a relative lymphocyte count under 20 per cent. —Ed.]

Roentgen Manifestations of Acute Intermittent Porphyria *were studied in 17 patients by George L. Calvy and Carroll C Dundon*[6] (Western Reserve Univ) who also reviewed the literature and found segmental gaseous dilatation of the intestine in at least half the patients Abdominal x rays vary in appearance from day to day and the disease has no characteristic pattern A continuous dilated loop of intestine may appear in the upper half of the abdomen on

(6) Radiology 58:204 208 February 1952

one film and be replaced by a scattered pattern of dilated loops a few hours later Short distended intestinal segments whose appearance changes on serial films are most common, sometimes a long dilated segment is noted Fluid levels may be demonstrable The colon, especially the cecum, may be dilated The typical "ladder pattern" of mechanical obstruction is seldom seen

Gastrointestinal manifestations of acute porphyria have been attributed to scattered areas of spasm in smooth muscle and intervening intestinal dilatation with resultant pain and tenderness Local or generalized spasm of the small intestine and cecum have been noted at laparotomy

Whereas diagnosis cannot be based solely on the x ray picture the radiologist must be acquainted with possible changes, since mention of this disease in differential diagnosis of problem cases will suggest the simple but conclusive laboratory test Diagnosis depends on demonstration of porphobilinogen in urine and feces by Watson-Schwartz test.

Of three clinical forms—light sensitive, acute intermittent and mixed—acute intermittent porphyria is most common It is frequently preceded with recent infection, fatigue trauma, puerperium or use of barbiturates, sulfonamides or alcohol Abdominovisceral crisis with signs of intestinal obstruction may usher in an episode of acute porphyria or the patient may show a neurologic disorder Urine is dark or mahogany colored or becomes so after prolonged exposure to light. Test results for porphobilinogen in urine are positive

Abdominal Injuries With Special Reference to Errors in Early Handling According to Russel H Patterson and Bertram Bromberg[7] (New York City) all abdominal injuries are prone to be followed with some degree of shock, and about 50% of deaths from penetrating abdominal wounds are the immediate result of hemorrhage and shock. A falling blood pressure remains the criterion of shock

In shock due to hemorrhage whole blood is the most reasonable therapy Stimulants are inadvisable and may do harm. Vasoconstrictors such as epinephrine and ephedrine increase the already existent vasoconstriction and tissue

(7) Am. J Surg. 83:427 433 March 1952

anoxia Use of nor epinephrine is also often impractical since it requires careful supervision The patient is best maintained at room temperature. Mild Trendelenburg position is advantageous, but rapid maneuvering to extreme position is dangerous. In complete collapse of veins, arterial transfusions are occasionally very successful. Oxygen may always be used but is most advantageous when there are associated chest wounds, burns or respiratory embarrassment Cardiac stimulants have no place in treatment, since the damage does not rest in the heart

Immediate treatment includes administration of morphine if necessary intravenously, for pain. Tetanus and gas antitoxin should be given early Every patient should have an initial standard dose of an antibiotic, further dosage to be determined by later findings Vital signs and fluid intake and output should be recorded Frequent aspiration of the pharynx and trachea is imperative, particularly in thoracicoabdominal wounds Insertion of a gastric tube is both diagnostic and therapeutic since in the critically injured, gastric function temporarily ceases, resulting in acute gastric dilatation. In examination for associated injuries, important diagnostic aids are signs of external violence, wounds bleeding from the rectum bloody vomitus or bloody aspirated gastric contents, hematuria and shoulder pain (diaphragmatic irritation) The perineum and back should be examined for wounds of entrance which occur in explosions or from bursting shells and are often at first overlooked. Sharply demarcated abdominal spasm may suggest thoracic rather than abdominal injury Abdominal distention of spinal injury appears early, in contrast to the distention of peritonitis Shifting dulness and, less often, absence of liver dulness are highly significant Auscultation should never be neglected and proctoscopic, manual rectal examination and catheterization are imperative X ray examination is a fruitful source of information.

Initial local treatment consists of dry sterile gauze and strappings. Antiseptics such as iodine and alcohol can leak into the abdominal cavity Because of possible spread of infection, treatment of entrance and exit wounds is deferred until laparotomy is completed Proper treatment is excision and closure with or without drainage

The decision as to the best moment for operation is difficult If blood pressure of 85 mm Hg or higher can be maintained with signs of subsiding vasoconstriction such as warm skin and slowing pulse, operation may proceed If operation is delayed at this time, blood is wasted, peritonitis may progress and an increased mortality is almost certain If the patient fails to respond to 2-4 pts whole blood there must be continued intraperitoneal bleeding and possibly further spread of infection Though the decision to operate at this point requires great judgment, surgery may save the patient's life For transfusion during surgery needles are inserted in the veins of both lower extremities and sufficient additional blood kept easily available A gastric tube is placed in situ Incision through the traumatic wound is dangerous and often leads to spread of infection and subsequent breakdown of the wound Transverse or unusual incisions are also avoided Gloves are changed several times during the procedure Penicillin 1,000 000 units/L, is introduced into the parenteral fluid At no time are powdered antibiotics introduced into the peritoneal cavity they are irritating and adhesions so produced are frequent causes of obstruction. In closing the abdomen the threat of subsequent evisceration should be kept in mind.

Nonpenetrating Abdominal Trauma With Special Reference to Lesions of Duodenum and Pancreas T L Bowman and F F Meilickes[8] (Bethlehem Pa) survey 67 cases of nonpenetrating abdominal trauma with 19 4% over-all mortality Incidence of subcutaneous abdominal trauma is rare among hospitalized civilians. Injury to liver spleen, kidney and the fixed solid viscera are most common. High mortality results from frequency of multiple concomitant injuries, whether intra abdominal or of the head chest diaphragm and pelvis Lesions of liver spleen, stomach and diaphragm show highest mortality

The survey included 34 operative cases. The 33 nonoperative cases included primarily mild trauma, contusion of the kidney patients in extremis and the multiple injured with delayed or concealed hemorrhage Of 18 patients with splenic ruptures, 9 associated with multiple injuries, 4 survived splenectomy All patients in whom splenic laceration was

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(8) Am J Surg 83 431 432 March, 195

the only trauma recovered after splenectomy One patient had retroperitoneal complete rupture of the duodenum between the 2d and 3d portions. Diagnosis was aided by flat abdominal x ray showing gaseous outline around the psoas muscle shadow Retroperitoneal crepitation lateral to a peculiar gray black hematoma was found in the mesentery of the ascending colon

Pancreatic lesions were numerous and included one in stance of complete pancreatic rupture with rupture of stom ach and duodenum, one of simple contusion of the head of the pancreas complicated by secondary suppuration of gall bladder and atonic obstruction of duodenum, and two of mild pancreatic trauma followed by development of pseudocysts

With multiple concomitant injuries particularly with the patient comatose, evidence of abdominal emergency may be difficult to evaluate Mortality will remain high if shock is not adequately treated. The critically ill need constant and repeated abdominal examination. Retroperitoneal rupture of the duodenum may be suspected when, with symptoms and signs of abdominal perforation, x ray shows gas outlining the right psoas muscle or in multiple small globules in retroperitoneal tissues or around the right kidney At operation crepitation beneath the right upper posterior peritoneum, a yellow or yellow brown discoloration of the peritoneum or a gray black or bile-colored hematoma in the mesentery of the ascending colon should raise suspicion of retroperitoneal rupture of the duodenum. Division of the gastrocolic omentum may be necessary to expose fully ruptures in the distal half of the duodenum

Pancreatic lesions from nonpenetrating trauma are con tusions, lacerations or complete ruptures Frequently other trauma is superimposed and mortality is high. Mild trauma or contusion of the pancreas may result in hematoma and development of pseudocysts. Persistent pain after mild abdominal trauma should suggest possible pancreatic lesion and cyst. In hematoma of the head of the pancreas, gall bladder and duodenum complications are possible

Treatment of pseudocysts of pancreas may be complicated by obstruction of the main pancreatic duct by fistula Ex cision of the cyst with or without partial pancreatectomy

cyst gastrostomy or cyst jejunostomy is the preferred treatment

Management of Foreign Bodies in Alimentary Tract.—Thomas D Grekin and Merle M Musselman[9] (Wayne County Gen'l Hosp, Eloise, Mich) reviewed data on 59 patients who had swallowed foreign bodies of various types. Sixty-three per cent of the blunt objects such as coins and closed safety pins and 80% of sharp objects such as glass fragments and razor blades passed spontaneously. Given an adequate trial, the most formidable of objects will usually pass spontaneously without harm to the gastrointestinal tract.

Esophagoscopy was done on 20 of 21 patients with esophageal foreign bodies. Reports indicate that most of these bodies will pass without trouble. Esophagoscopy should be done if the object is above the cricopharyngeus muscle, if it shows no progress in 24 hours or if the patient has esophageal symptoms and an x-ray suggests a radiolucent foreign body. In patients with symptoms or signs of obstruction, hemorrhage or mediastinitis, removal of the foreign body by esophagoscopy or thoracotomy is indicated.

Of 38 patients with gastrointestinal foreign bodies operation was necessary on 4. In retrospect, two of the four could have been treated conservatively. There were two gastrotomies, one duodenotomy and one ileotomy. The objects passed spontaneously in 31 instances and had to be removed from the rectum in 3. Perforation of the lower ileum occurred in only one patient and none had obstruction.

Operative treatment is indicated if a foreign body fails to progress, is unlikely to pass spontaneously or is likely to penetrate the bowel, if there are symptoms or signs of obstruction, mediastinitis or peritonitis, and if gastrointestinal hemorrhage has occurred.

[Perforation of the esophagus is always a very serious condition. The treatment of foreign bodies in the esophagus should therefore be of such a kind as to prevent the perforation and to close it promptly if there is evidence of its occurrence. If history and symptoms are definite, particularly if object is sharp, in my opinion it is safer to remove the object by esophagoscopy than to rely on the hope it will be passed into the stomach. If there is suspicion of perforation prompt thoracotomy is desirable.—Ed.]

(9) Ann Surg. 135 528-535 April, 1952.

Use of Thoracicoabdominal Incision for Upper Abdominal Neoplasms is described by John M. Beal and William P. Longmire, Jr.[1] (Los Angeles) find that this incision permits determination of resectability without division of important structures and affords excellent exposure in block removal of massive neoplasms.

PROCEDURE.—The patient is placed so that the transverse axis of the body is at 30 degrees to that of the table. The left side is elevated. An oblique abdominal incision is made from the lateral margin of the right rectus to a point approximately opposite the seventh left intercostal space. If exploration discloses hepatic metastases or peritoneal implants, operation can be discontinued or a palliative procedure performed. If resection seems feasible, incision is extended into the seventh intercostal space by division of the costal margin (Fig. 122). Resection of 2-3 cm. of costal cartilage at the site of transection facilitates closure. The diaphragm is incised toward the esophageal hiatus; during division, the lower lobe of the left lung is carefully retracted and a rib-spreading retractor inserted and gradually extended. When neoplasms involve the cardia, *the esophagus is circumscribed and a few centimeters of diaphragm* left attached to it.

For mobilization of upper abdominal viscera the lateral reflection of the posterior parietal peritoneum is incised from the esophageal hiatus to the inferior pole of the kidney (Fig. 123). By retracting the spleen medially, the tail of the pancreas is readily mobilized and a relatively avascular plane entered. Retropancreatic dissection is continued up to where the superior mesenteric artery and vein can be visualized (Fig. 124). In some large neoplasms involving abdominal structures above the transverse mesocolon, involvement of these two vessels determines operability. Also an opportunity is afforded to inspect the nodes along the aorta. If excision of the tumor is feasible, operation is continued and the transverse colon omentum removed. If either the transverse colon or mesocolon is involved, the portion of colon between the hepatic and splenic flexures is removed. Otherwise, the peritoneum from the upper surface of the *transverse colon is reflected and removed. In most cases* the duodenum may now be divided about 5 cm. distal to the pyloric ring. The pancreas is divided between sutures passed around its neck. With this exposure there is little difficulty in dissecting the pancreas from mesenteric vessels. The splenic vein is transected. The periportal lymphatics are dissected, leaving the common duct, portal vein and hepatic artery exposed. The gastrohepatic ligament is incised at the margin of the liver and reflected medially. By tracing the hepatic artery cephalad, injury to this vessel is avoided. After division of splenic and left gastric arteries, the tumor mass is retracted upward over the superior margin of the incision (Fig. 125). Its remaining attachment is to the esophagus. If complete removal

(1) A.M.A. Arch. Surg. 64: 609-615, May, 1952.

is not required the stomach is transected at an appropriate level, possibly without division of the left gastric artery, and continuity of the gastrointestinal tract restored by gastrojejunostomy In total gastrectomy, a suitable length of esophagus is mobilized for esoph

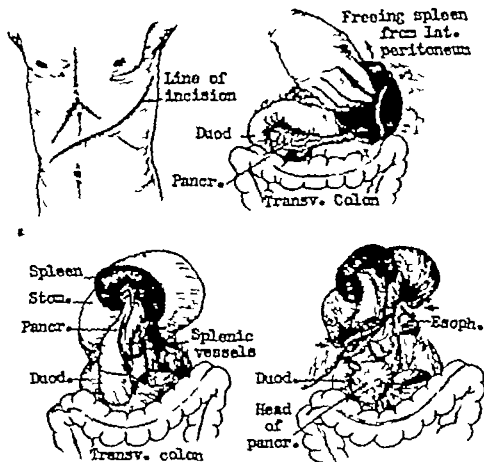


Fig 122 (top left).—Incision for thoracicoabdominal approach to upper abdominal neoplasm.
Fig. 123 (top right) —Initial step in mobilization of upper abdominal viscera.
Fig. 124 (bottom left) —*Retroperitoneal approach to determine operability avoids division of important structures*
Fig. 125 (bottom right) —Completed block resection of stomach, spleen and distal pancreas.
(Courtesy of Beal, J M., and Longmire, W P., Jr: A.M.A. Arch. Surg. 64:609-616 May 1952.)

agojejunostomy The chest is usually closed without drainage. When the pancreas is transected, a drain is brought through the abdominal wall from the left upper posterior peritoneal space.

Prolonged Intercostal Nerve Block in Upper Abdominal Surgery W J Puderbach and H. E. Shaftel[2] (Brooklyn) stress that atelectasis and pneumonia, common postopera

(2) Journal-Lancet 72:200-204 April, 1952

pieces of tissue and soaking surgical gut in too hot water, apparently had little influence on wound separation. Of 94 instances of dehiscence in period 2, 82 had vertical (rectus or midline) incisions, seven had oblique and five transverse incisions Fewer instances of disruption occurred in the latter two anatomic types of incisions than in vertical incisions Retention sutures, which prevented evisceration but not wound separation, were used in about one fourth of these patients Inaccurate closure, particularly loose closure around a drain, apparently is an important factor in wound dehiscence, the omentum insinuating itself through such a suture line gap Sutures placed too tightly about a drain may cut through tissue and produce wound separation. For accurate closure relaxation of the abdominal wall is essential

Postoperatively, increased intra-abdominal pressure through cough, vomiting and/or distention was present in 78 8% of the period 1 patients and 81 9% of the period 2 patients. Activity including early ambulation, by preventing atelectasis and distention, has possibly decreased dehiscence incidence Wound infections may cause wound dehiscence but frank wound infection appeared in only a little over 3% in both groups Hematoma was not an evident factor in either period.

Serosanguineous drainage, present in 50% of the cases in both periods, proved the most pathognomonic sign of wound disruption. The patient often complained that 'something gave way" A loop of bowel may be palpated in the wound while the dermal sutures are in place or the loops of small intestine may be lying outside the abdomen. Dehiscence begins within three days after operation, but may not become obvious until dermal sutures are removed most cases in both periods became evident after 5 10 days.

Prophylactically malnutrition, avitaminosis, dehydration and anemia should be corrected. Elective laparotomy is inadvisable in bronchitic or excessively obese patients Post operative activity should be encouraged Anatomic incisions are to be used when optimal exposure can be obtained Trauma should be avoided and accurate peritoneal closure secured Drains should be brought out through a stab wound Retention sutures should be used in patients with

preoperative cough, debility, extreme obesity or advanced carcinoma Postoperative cough is to be encouraged only if atelectasis occurs Gastric suction should be used for distention or vomiting but is not used routinely by the authors A scultetus binder is used postoperatively

When discovered, the eviscerated bowel is covered with a sterile dressing and the abdomen taped Gastric contents are aspirated and the tube left in place Fluids are given intravenously and transfusion is begun Use of thiopental sodium and curare for anesthesia in period 2 rather than the ether of period 1 resulted in smoother convalescence Resuture may be by through and through silkworm alone or with supplementary layer closure when the layers are identifiable Attention to layer closure seemed to be more efficient particularly in prevention of subsequent ventral hernia. Of nine instances of ventral hernia after secondary closure in period 2, six followed use of through and through sutures only One wound separation after secondary closure occurred in period 1 none in period 2 Secondary closure was done within 24 hours in 69 2% in period 1 and in 74.5% in period 2

Full supportive treatment, including transfusion antibiotics, oxygen fluids intravenously and vitamins and gastric suction, was given during period 2, in contrast to transfusion alone (in only 7 7%) in period 1 The mortality rate of 34 6% in period 1 was reduced in period 2 to 18 1% Improved anesthesia and postoperative measures seemed to be the main factors in this reduced rate

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HERNIA

Diaphragmatic Hernia of Liver is discussed on the basis of one case by Mario M Brea, Andres A. Santas and Abel Gilardon.[5]

Routine x ray examination of a woman, 39 disclosed an abnormal shadow She was asymptomatic, although 15 years earlier she had had some pain in right hypochondrium on coughing Routine studies gave normal results except for 5% eosinophilia and a positive Casoni reaction Anteroposterior x ray views showed a density

(5) Bol. y trab Acad. argent. cir 35:175 181 May 1951

with a sharp, horizontal upper border in the lower right hemithorax in the lateral view the border was convex upward. Pneumoperitoneum was used for further studies, this caused collapse of the right lung and pneumothorax. Then the left hemidiaphragm was visualized radiologically, but the right was not. The films were diffuse and correct interpretation was possible only in retrospect. Diagnosis was hydatid cyst of the thorax, and exploration was done by anterolateral thoracotomy The upper two thirds of the liver were found in the thorax, at the hernial ring there was pronounced indentation of the liver The organ was replaced in the abdominal cavity With no hernial sac, the pleural and peritoneal cavities communicated. A gap in the right hemidiaphragm, extending from the central tendon to the costal insertion, was noted, this may have been formed by failure of fusion rather than by agenesis and was easily closed. Recovery was uneventful.

Spigelian Hernia Hernia through Linea Semilunaris. Cecil Wakeley (London) and Peter Childs[6] report four cases Figure 126 shows the sites.

Case 1.—Man, 60, was a stoker He had a painful lump the size of a baseball on the right side of the umbilicus for two years. Under

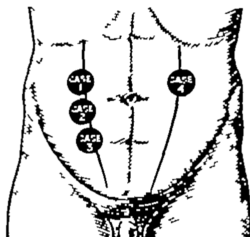


Fig. 126.—Sites of spigelian hernias. (Courtesy of Wakeley C., and Childs, P Lancet 1:1290-1291 June 16 1951.)

general anesthesia a transverse incision was made. A hernial sac containing omentum and part of the transverse colon was excised after resection of the omentum and return of the transverse colon to the abdomen. The defect was closed with mattress sutures. Examination 2½ years later showed no recurrence.

Case 2.—Woman, 55, was married and obese. She had a painful lump to the right of the umbilicus which had appeared 18 months previously, after the birth of her sixth child. Under local anesthesia

(6) Lancet 1 1290-1291 June 16 1951

a hernial sac containing omentum and cecum was exposed through a transverse incision. The omentum was resected and the cecum returned to the abdomen After excision of the sac the defect was closed Recovery followed.

CASE 3—Woman 62, married had a lump on the abdomen below and to the right of the umbilicus It was about the size of a hen's egg and disappeared during recumbency Under general anesthesia a transverse incision was made exposing a sac which contained omentum and cecum. The omentum was excised the cecum put back in the abdomen and the defect closed. Recovery followed

CASE 4.—Woman, 53, married, had constant severe pain on the left side of the abdomen for four months which was aggravated by coughing There seemed to be a small tender nodule about 3 in. to the left of and 1 in. above the umbilicus After injection of 10 cc procaine into the area, the pain disappeared for five days which enabled the patient to sleep Since the pain returned, a transverse incision was made under general anesthesia. A fatty hernia, 0.5 × 1 0 cm., was seen emerging through the semilunar line accompanied by a small vessel The fatty lobule was excised and the defect closed Relief from pain ensued.

In Case 4 the hernia was clearly associated with a blood vessel. This corroborates the view of certain authors that the hernia escapes through a vascular foramen. A lump and/or pain are the usual symptoms. When there is no definite palpable lump as in Case 4, diagnosis may be difficult The pain is usually made worse by straining

These hernias present a danger of strangulation. Intestinal obstruction has been reported in association with them. Removal of the hernial sac and repair of the defect by the Mayo overlap method with mattress sutures are indicated

Incarcerated Inguinal Hernia in Childhood. Olle Wiklander[7] (Stockholm) states that incarceration of inguinal hernia is common in children. Among 1 053 patients with inguinal hernia seen during 1940-45 the incidence of incarceration was over 10 per cent In 90 of the 111 cases it was of only a few hours duration in 14 it had been present for 12 hours, in 4 for 24 in 2 for 36 and in 1 for 72 hours Serious impairment of the circulation of the intestine did not occur in any of the children. In 12 of 101 operated on there was moderate to pronounced hemorrhagic infarction of the testis 11 of these were under age 1 Attempted reduction of the hernia and torsion of the testis were not causes of infarction In 10 of the 12 children with interference of tes-

(7) Acta chir scandinav 101:302-311 1951

ticular circulation, the hernial sac was "congenital," i.e., connected with tunica vaginalis The spermatic cord was intimately connected with the hernial sac and often en closed in a fold at the neck leading to constriction of the spermatic vessels.

To determine the condition of the testis, follow up was done on 79 patients Irreversible damage had occurred in 10 per cent. Of 11 with primary disturbances of circula tion, 1 had undergone ablation of the testis, 3 had almost complete atrophy, 2 had smaller and firmer testes than on the healthy side and 5 had normal testes. Four others had pronounced atrophy Three with undescended testis on whom orchidopexy was done had atrophied testis.

Treatment for incarcerated inguinal hernia begins with reduction radical operation is not performed until a day or so later, when it is then easier to carry out. Reduction alone was done in 5 of the 111 cases. It was successful in about half the other cases and radical operation was done later in half, operation was done immediately Reduction is performed only when there is no swelling of the scrotum or the inguinal region that may give rise to difficulties in differential diagnosis In the presence of definite contra indications to immediate operation, reduction may be justi fied but is generally not advisable

Damage to the testes might possibly have been prevented in half the present cases if operation had been performed as soon as possible after the discovery of hernia The opera tive risk in infants from as early as age 4 weeks is not considered greater than in older children.

Results of Primary Inguinal Hernioplasty Louis T Pa lumbo, R E Paul and F B Emery[8] (V A. Hosp., Des Moines, Ia.) describe a repair technic and analyze results of 642 primary inguinal hernioplasties in 564 males, 85 4% of whom had follow up for one to four years. Spinal anes thesia was used in most operations. Nonabsorbable cotton sutures were used in 37 8 and silk in 62.2% The operation is a modification of combined Bassini Halsted and Andrews procedures.

TECHNIC.—The skin is incised obliquely above the pubic spine and upward to and about 5 cm. medial to the anterosuperior iliac

(8) A.M.A. Arch. Surg 64 384 394 March, 1952.

spine The external oblique aponeuro is is split along its fibers medial to the cord After the leaves of the external oblique aponeurosis are mobilized the cord structures are freed and displaced laterally from their bed. If there is an indirect sac it is dissected from the cord structures high up to the internal ring, any direct sac found is pulled up with it, converting the hernia into one sac Purse-string suture is used for high ligation of the sac, which is transplanted and anchored to the abdominal wall Interrupted imbricating sutures of 000 silk in the transversalis fascia and muscle form a solid foun

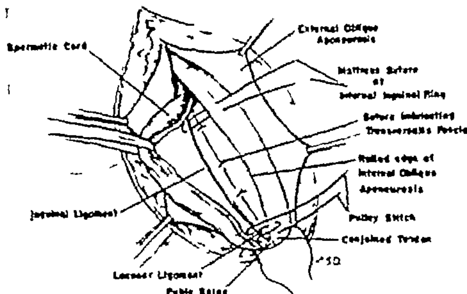


Fig. 127 —Interrupted 000 silk sutures imbricate transversalis fascia and muscle in Hesselbach's triangle Horizontal mattress suture forms the lower border of the internal inguinal ring to bring the cord out of the abdomen at a right angle The pulley stitch obliterates and reinforces the weak area behind the pubic spine (Courtesy of Palumbo, L. T et al A.M.A. Arch Surg 64:384-394 March, 1952)

dation for the hernia repair (Fig 127) A puller switch in 00 silk is placed over the pubic spine behind which most recurrences cause defect. The stitch starts with the needle through the conjoint tendon or the medial aspect of the internal oblique aponeurosis above the pubic spine, then passes through the inguinal ligament at its point of attachment to the pubic spine, the same suture continues in parallel stitch up and through the internal oblique aponeurosis close to the first stitch and finally sweeps behind the pubic spine area, through the lacunar ligament and out the free margin of the inguinal ligament near the suture above the pubic spine. When tied, the suture approximates structures superior to and above the pubic spine area (Fig 128)

The lower border of the internal ring is formed with a horizontal mattress suture of 00 silk approximating the free rolled edge of the internal oblique aponeurosis to the shelving of the inguinal ligament. The upper border of the internal inguinal ring is formed by

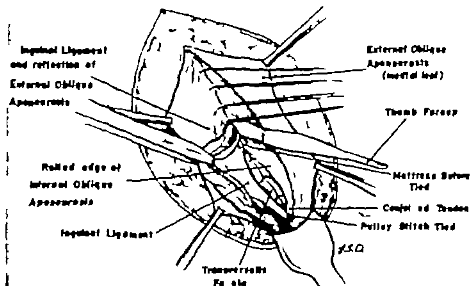


Fig. 128.—Pulley stitch and mattress sutures are tied. Rolled edge of internal oblique aponeurosis is sutured to the inguinal ligament with 00 silk. Blunt end of thumb forceps shows relative size of internal ring. (Courtesy of Palumbo, L. T., *et al.*: A.M.A. Arch. Surg. 64:384-394 March, 1952.)

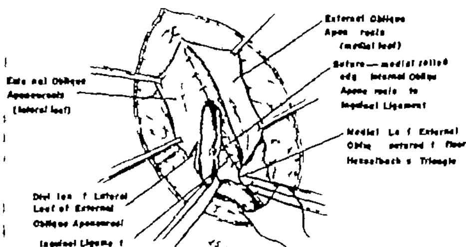


Fig. 129.—Second layer of aponeurosis-to-aponeurosis repair. Internal oblique aponeurosis or conjoined tendon is sutured with 00 silk to shelving of inguinal aponeurosis in Hesselbach's triangle. Lateral leaf of external oblique aponeurosis is divided for 1.9 cm. below lower border of internal ring. Medial cut leaf of external oblique aponeurosis is sutured with 000 silk to floor of Hesselbach's triangle. (Courtesy of Palumbo, L. T., *et al.*: A.M.A. Arch. Surg. 64:384-394 March, 1952.)

suturing the rolled edge of the internal oblique aponeurosis to the inguinal ligament. Then the rolled edge of the internal oblique aponeurosis is drawn to the inguinal ligament below and above the cord with interrupted 00 silk sutures. The lateral leaf of the ex

ternal oblique aponeurosis is split toward the inguinal ligament, at right angles to its fibers, about 3/4 in. below the lower border of the newly formed internal ring (Fig 129) The divided medial and lateral leaves of the external oblique aponeurosis inferior to the internal ring is then imbricated and sutured to the newly formed floor of Hesselbach's triangle Operation is completed by reapproximating cut leaves of the external oblique aponeurosis above the cord to form a new external ring The superficial fascia and skin are closed routinely

With seven recurrences, rates for patients ambulatory on the 1st, 7th and 14th days were 1 7, 0.95 and 2.04% Recurrence for total number of operations was 1.29% Early ambulation therefore has no bearing on recurrence rate.

There were 99 postoperative complications, 20% involving the wound Incidence of complications depended on the day of ambulation 7 2% of those ambulatory on the 1st day had complications as against 19.5% and 21 6% of those ambulatory on the 7th and 14th days Early ambulation also reduces postoperative respiratory, gastrointestinal and urinary tract complications considerably

Study of Types of Recurrence Following Inguinal Herniorrhaphy Sigmund Zawacki and E. T Thieme[9] (Ann Arbor Mich) studied 105 recurrent inguinal hernias and classified them as to type of recurrence found at reoperation. Since this was not a follow up study, no criticism of any one surgical technic is offered No correlation can be reported between type of recurrence and type of the original hernia age of patient or type of original operation. There was no correlation between type of recurrence and time interval from the original operation to recurrence. A correlation did exist between type of recurrence and length of time the recurrence was endured by the patient, in that the longer it was present the larger the defect tended to be.

Fifty-one per cent of the hernias recurred within one year of operation 24% within five years and 25% after five years. Recurrences at the internal ring, which accounted for 52% fell into three groups In one the hernias were sharply localized at the internal ring, in another they were above and lateral to the ring and in the third they were of the classic well developed indirect inguinal type. There was a sharply localized defect at the pubic tubercle in

(9) A.M.A. Arch. Surg 63 505-510 October 1951

23% of cases and in 24% a complete breakdown of the floor as a typical direct hernia. In 75% of the recurrences it would seem that the error at the original operation had been failure to obtain an accurate closure of the internal ring and a firm first stitch at the pubic tubercle Any type of surgical repair which includes these two steps, as well as high ligation of the indirect sac, will be successful

It is important to operate early on recurrent hernias because an appreciable number of large direct or indirect recurrences start as small defects

Recurrence Rates of Lateral Inguinal Hernia in Adults are reported by Stig Borgström[1] (Lund, Sweden) on the basis of questionnaires 1 14 years postoperatively answered by 744 men aged 25 or older All had had acquired unilateral, indirect (i.e., "lateral") reducible inguinal hernia repaired with no postoperative complications General recurrence rate was 11 8 ± 1 18% with 55% recurring in one year and 87% in five years

Among factors that could not be influenced age and weight played no part. However manual laborers had fewer recurrences than others Furthermore the recurrence rate increased in proportion to the size of the hernia in manual laborers but not in nonmanual workers.

Various factors that could be influenced are discussed (1) The operative method in which the fascia was closed in front of the cord with medial emergence of the cord (Bassini technic) probably has a lower recurrence rate than that in which the fascia is closed posterior to the cord with lateral emergence of the cord (Halsted technic) (2) Recurrence after herniorrhaphy is higher for surgeons with only up to three years' experience in operating than for the more experienced. (3) Recurrence, on a probable statistical basis, increases when the postoperative recumbency period is three days or less. (4) For both manual and nonmanual workers, recurrence rate increases in proportion to the length of the convalescent period beyond four weeks, on a probable statistical basis. Borgström concludes that the period of recumbency should be revised upward, possibly to four or five days, while the convalescent period should be limited to four weeks.

(1) Acta chir scandinav 101:420-443 1951

Femoral Hernia Operative Cases at Johns Hopkins Hospital during 21 Year Period Amos R Koontz[2] reports on 139 patients, 93 female and 22 Negro most were aged 40-50 and 84% were 30-70 Only five had bilateral hernias eight had concomitant inguinal hernias, three had sliding hernia with bladder as the viscus, and only five had recurrent hernias

The sac contained omentum or ileum in all but two patients in whom it contained the appendix and one that contained the sigmoid In 10% hernia was incarcerated and in 26 6% strangulated In 37 strangulations, the ileum was involved 33 times the omentum 3 times and the appendix once In eight patients the ileum had to be resected Five had Richter's hernia, all strangulated

Over all 3 6% mortality is low in view of high incidence of strangulation and incarceration Mortality rate for strangulation was 10 8%

The approach was femoral in 46 5% inguinal in 34% combined in 16 7% and abdominal in 2 8% Three different types of incision were used for the femoral approach (1) vertical incision over the femoral hernia (2) oblique incision parallel to and below Poupart's ligament, and (3) a hockey stick incision starting parallel to Poupart's ligament and curving down over the femoral hernia The combined approach was used when the strangulated bowel could not be handled properly from below In femoral repair the usual operation was done employing pectineus fascia, falciform process and Poupart's ligament to close the femoral opening with either purse-string or mattress sutures. In the inguinal approach either the inguinal ligament or the conjoint tendon was sutured to Cooper's ligament completely blocking off the femoral canal Only gynecologists, who found the femoral hernia while operating on some other abdominal condition, used the abdominal approach

(2) A.M.A. Arch. Surg 64 295 306 March 1952

LIVER AND SPLEEN

Role of Superior Mesenteric Artery in Hepatic Vasculari zation Eugenio Marcos Cavalcanti[3] (Fac Nacional de Med., Rio de Janeiro) investigated the part played by the superior mesenteric artery in the blood supply of the liver and found that it does so in four distinct ways (1) indirectly, by a common mesenteric celiac trunk, whence the hepatic artery emerges, (2) by a thin hepatomesenteric branch, so small in caliber that it is devoid of practical importance, (3) by a large hepatomesenteric branch constituting a genuine accessory artery called the right accessory hepatic or the hepatomesenteric artery, and (4) by a hepatic artery ex clusively of mesenteric, rather than celiac, origin. The first two forms require no special study the third and fourth are more common and are significant in surgery

The right accessory hepatic or hepatomesenteric artery originates in the superior mesenteric artery and enters the right lobe of the liver completely or partly replacing the right branch of the hepatic artery proper Through most of its course, it is situated deeply and behind the pancreatic head, portal vein and choledochus after passing the choledochus it emerges from its deep position to cross in front of the right branch of the portal vein. Its relation to the inferior vena cava and the cava renal junction, from which it is separated by the fascia of Treitz, is most important, if during splenorenal anastomosis it should accidentally be *ligated, blood supply to the right hepatic lobe would in* evitably be impaired Its only constant collateral is the cystic artery which emerges from the hepatobiliary seg ment in the area of Budde's triangle The right lobe of the liver is usually supplied exclusively by the right accessory hepatic artery in the 10% of individuals in whom it occurs, and in whom it is ordinarily the only anomaly about one fifth of the patients who have it, however also have a left accessory hepatic artery or hepatocoronary branch

The hepatic artery may originate entirely in the superior mesenteric artery constituting its first important collateral

(3) Rev brasil. cir 22 267 276 October 1951

Like the hepatic artery of celiac origin, its course is divided into two segments forming the sides of a near right angle, from the vertex of which the gastroduodenal artery emerges, marking the division between the segments. Its collaterals are generally similar to those produced by the celiac hepatic artery and it terminates in the same manner usually dividing into two branches. It occurs in 2-3% of patients.

Portal Circulation in Experimental Hemorrhagic Shock In Vivo Roentgen Ray Studies Edward W Friedman Howard A. Frank and Jacob Fine[4] (Beth Israel Hosp, Boston) visualized the portal and hepatic veins in dogs by use of contrast mediums during hemorrhagic shock and found that the macroscopic portions of these veins were constricted. It is assumed that there is generalized venous constriction in the liver In normal dogs, injection of epinephrine or faradic stimulation of the hepatic plexus reduced the vessel cross-section area, whereas histamine produced no change. Hemorrhagic hypotension decreased the vessel size, the constriction occurred soon after bleeding started and persisted with unchanged intensity during the subsequent two to three hours of hypotension. X rays taken 15 20 minutes after blood volume replacement showed widening of the vessels to 38-88% of the original dimensions In the subsequent few hours constriction to 15-63% of the original area recurred Films taken 40 minutes after administration of dibenamine® showed widening of the veins regardless of the stage of shock. Hemorrhagic shock induced four to six weeks after bilateral division of the splanchnic nerves and sympathetic trunks at the level of the diaphragm was accompanied by less than the usual degree of constriction of the portal venous system.

The intrahepatic vascular constriction is active rather than passive as suggested by the observation that replacement of the blood volume deficit is accompanied by a rise above normal in portal pressure without restoration of the normal caliber of the veins whereas dibenamine® restores normal caliber of the veins whether blood is transfused or not. The intrahepatic vasoconstriction persists throughout the shock period and appears to be a local manifestation of

(4) Am. Surg. 134:70 79 July 1951

the generalized vasoconstriction in shock. This is media in part by the sympathetic nervous system.

No information has been gathered regarding reactions the intrahepatic venules, it may be that much of the crease in resistance occurs in this area for there is evide that pre and postsinusoidal sphincters play an import part in controlling intrahepatic blood flow

As a result of the sustained intrahepatic resista throughout the shock state, the splanchnic vessels beco congested, intestinal hemorrhage eventually occurs a if the plethora is of sufficient magnitude, hemoperitone may also develop Progressive congestion of the portal s tem is a function of the summation of volume flow into portal system, on the one hand, plus total resistance escape of flow into the vena cava, on the other Since the result of intrahepatic resistance to flow is a deficiency flow into the vena cava, with resulting persistent deficien in cardiac output, the cumulative incarceration of blo in the portal system acts to nullify in part the effectiven of blood given in an attempt to restore adequate circulat volume

Portal Venography Preliminary Report Charles Child III Ward D O Sullivan, Mary Ann Payne and R D McClure Jr[5] (New York Hosp Cornell Med. Cente performed portal venography in over 30 Macaca mula monkeys and found the method safe enough to use in patients during exploratory celiotomy or definite surge for cure of intra abdominal disease In man, the super mesenteric vein was isolated at the base of the mesocol and portal pressure measured with a 15 gauge needle a spinal manometer A 50 ml Luer Lok syringe was used inject 40 ml. 35% diodrast* solution rapidly into the port vein. All x rays were taken with a 15 ma portable machi and grid cassette Exposure was always made during d livery of the last few milliliters of diodrast.* No fatality morbidity which could be ascribed to the procedure w recorded.

Final evaluation of the diagnostic worth of the procedu requires accumulation of further experience The procedu is simple and does not add to over all surgical risk.

(5) Radiology 57 691 701 November 1951

In several instances, particularly in patients with pancreatic cancer the outline of the portal vein and its branches indicated advisability and type of surgery In two patients with portal hypertension due to cirrhosis x ray evidence of liver enlargement was provided by the extent of the venous pattern Complete occlusion of the portal vein in inoperable gastric cancer was seen In one case portal hypertension due to extrahepatic block was evidently caused by displacement of the portal vein and anastomosis to the vena cava was abandoned In animals the method has facilitated study of dynamics of the portal system

Portal Embolism Following Thrombosis of Splenic Vein and Causing Infarct-Like Cyanotic Atrophy ("Zahn's Infarcts") of Liver Complication of Splenectomy Performed in the Course of Total Gastrectomy W St C Symmers[6] (Univ of Birmingham) states that the liver lesions known as Zahn's infarcts resemble but are not true infarcts and are more appropriately designated "infarct like red or cyanotic atrophy" Essentially they are occlusions of medium caliber veins of the portal system resulting in single or multiple deep red firm roughly pyramidal lesions with base at the liver surface varying from 1 cm in diameter to involvement of most of a lobe The lesions are localized areas of circulatory stasis, combined with atrophy and degeneration of the parenchymal cells, but with little or no necrosis.

The common immediate cause of a Zahn infarct is sudden occlusion of a branch of a portal vein by thrombosis or embolism. Additional factors must also be operative including (1) congestive heart failure retarding drainage of blood from the liver and/or (2) peripheral circulatory failure causing lowering of arterial blood pressure (shock) which operate through diminution of portal blood flow and of the anastomotic arterial supply to the liver tissues Occasionally the total circulatory disturbance is enough to produce a true hemorrhagic infarct.

The reserve capacity of the liver is such that Zahn's infarcts cause no appreciable functional disturbances unless preceded by serious degenerative parenchymal changes However occlusion of the main right or left branch of the

(6) Brit. J Surg 38 495-502 April, 1951

portal trunk produces *severe atrophy of the corresponding* liver lobe and compensatory hypertrophy of the unaffected lobe

Symmers summarizes three fatal cases of total gastrectomy and splenectomy In two, fatal on the 6th and 7th postoperative days, Zahn infarcts were found in the livers with no apparent loss of parenchymal tissue In the other case, with death the 3d day in peripheral circulatory failure, despite embolic occlusion of several portal branches no infarct like areas were present, presumably because death occurred before morphologic changes could result. These deaths are attributed to a combination of factors degenerative changes in the viscera from toxemia and circulatory inadequacy, infection, pulmonary collapse and intestinal obstruction Although the Zahn infarcts are not fatal per se, it appears that their occurrence still further diminishes hepatic functional reserve with serious consequences. Moreover, the autolytic products released from Zahn infarcts increase the demands on the detoxifying capacity of the rest of the damaged liver and augment toxemic effects on the cardiovascular system. Additional damaging factors in these cases were nutritional disturbances for which operation was done, sepsis of ulcerated carcinoma, prolonged anesthesia and impairment of cardiovascular activity by prolonged surgery

Symmers believes that although many of these factors cannot be eliminated the Zahn infarct can be prevented by *proximal ligation of the splenic vein as near as possible to* the point where it receives its inferior mesenteric (or other anomalous) tributary whereby free circulation is maintained, since the farther away from this site the ligation is made, the greater will be the volume of thrombus formed with embolic potential for the portal vein branches Although thrombus still will form its detachment is far less *damaging to the liver since it is small when the portion of* the splenic vein with stagnant blood in it is eliminated. Use of anticoagulants in these cases is contraindicated because of danger of hemorrhage

In contrast to these cases of gastrectomy combined with splenectomy are those of simple splenectomy in which parenchymatous liver lesions are not found. This is probably due

to the comparative youth of the patients, comparative shortness of the operation and absence of malignancy, nutritional deficiencies and shock

Thrombosis of Hepatic Veins (Budd Chiari Syndrome) According to Ph Detrie[7] (Paris), this rare disease is almost never diagnosed in the living patient It is equally common in both sexes, predominantly between 20 and 40 Thrombosis may be primary or the result of an intrahepatic (neoplasm, inflammation, cirrhosis) or extrahepatic lesion (trauma, perihepatitis, neoplasm, constrictive pericarditis or such thrombotic disease as hyperglobulinemia) or it may follow spread of phlebitis of the vena cava Numerous theories have been proposed to explain why the primary disease is so localized

Acute and chronic forms have been observed The first is violent in onset with severe malaise and such digestive disturbances as abdominal pain, nausea and vomiting Diagnosis depends on appearance of ascites, which forms rapidly and is refractory to usual treatment After tapping, a large, painful, tense liver, without splenomegaly, is palpable The disease progresses rapidly and is fatal in one to four weeks. The chronic form has initial symptoms referred to indigestion: fulness in epigastrium or right hypochondrium and nausea Ascites forms slowly cyanosis may develop, but icterus is rare Edema of the lower limbs is late and probably corresponds to caval extension of the thrombosis. Death supervenes within six months

Although ascites and hepatomegaly, the only symptoms, are meager clues, clinical diagnosis has been based on their isolated character Heart and lungs are normal, there is no history of alcoholism. In cirrhosis, ascites does not develop so rapidly, the liver is never so hypertrophied nor its insufficiency so pronounced. Thrombosis of the portal and splenic veins involves no hepatomegaly Biopsy is the best diagnostic tool as the heart and vena cava are intact, the central lobular congestion and necrosis localize the area of the disease

Bacteriologic Study of Human Liver Claude Romieu and Alexander Brunschwig[8] (New York City) made bac-

(7) Presse méd. 60 392-393 Mar 22 1952
(8) Surgery 30 621-633 October 1951

teriologic studies on human liver and found that this organ does not normally contain viable bacteria which under certain conditions may become pathogenic Liver tissue was secured at the time of laparotomy from 12 patients operated on because of malignant neoplasms in the lower abdomen. The segments weighing 200-500 mg., were incubated for three weeks in fluid thioglycollate medium and in brom cresol purple milk. In 10 patients all the cultures were sterile, in 1, Bacillus pyocyaneus was recovered on the third day This organism was also recovered from the bladder urine and from the operative wound, it is postulated that the pyocyaneus is not a normal habitant of the liver The growth of diphtheroids in one patient is interpreted to represent contamination In no instances were there postoperative complications due to biopsy of the livers

The human liver in the patient without inflammatory disease of the extrahepatic biliary tract or from acute or severe chronic bowel obstruction must be regarded as free from viable pathogenic organisms. In the presence of a large infected intra abdominal neoplasm or peptic ulcerations bacteria could enter the liver but in the normal human subject there does not appear to be a "normal" hepatic flora.

[An interesting and important observation in contrast to the findings in the dog's liver—Ed.]

Primary Carcinoma of Liver In 797 consecutive autopsies, 14 primary carcinomas of liver were observed by Harold J Schupbach, Jr., and Raid B Chappell[9] (Memphis) The various etiologic factors were not clear-cut, but cirrhosis was found in 57% Illness was usually brief. Progressive portal hypertension, nodular enlargement of liver and ensuing cachexia warranted serious consideration of primary liver neoplasm. Spider angiomas, jaundice pain in the right upper quadrant and right side of chest and impairment of liver function were variably noted. Significant laboratory studies were those indicating hepatic dysfunction. Of 14 growths, 2 were cholangiomas, 7, hepatomas and 5 mixed tumors bile ducts predominated in three and hepatic cells in three All patients had pronounced liver enlargement 9 had splenomegaly 12 had extrahepatic metastases 2 with

(9) A.M.A. Arch. Int. Med. 89 430-444 March, 1952.

no extrahepatic metastases had multiple intrahepatic spread Relative malignant tendency, as manifested by number of mitoses and cellular pleomorphism was not correlated with rapidity of clinical course Despite little cause for optimism, this experience indicates that more frequent surgical exploration is warranted in the hope that solitary liver tumors can occasionally be successfully resected

Ligation of Hepatic and Splenic Arteries in Treatment of Portal Hypertension. Jacob K. Berman, Harry Koenig and Lullus P Muller[1] (Indiana Univ) found that ligation of the hepatic and splenic arteries will produce a sustained fall in portal venous pressure and recommend the procedures in portal hypertension of liver cirrhosis. Studies of the normal liver show that the hepatic vein has no anastomosis with either the portal vein or hepatic artery except through the sinusoidal bed and the two venous systems are always separated by parenchyma The hepatic artery has a small volume circulation with a high pressure, whereas the portal vein has a large volume circulation with a low pressure There is a common channel of exit for blood entering these two circulations, the circulations lie in an expansible tissue framework and all circulations influence each other The freely expansible tissue framework is the most important factor toward maintaining the proper balance between the portal circulation and the hepatic artery circulation The hepatic vein is a separate unit without free communication Osmotic pressure within the portal vein is high favoring the rapid absorption of solutes into the portal system

In cirrhosis there is a dissociation between the portal and hepatic venous systems so that the free exit of blood from the portal sinusoids into the central vein is delimited The portal pressure increases and a more direct communication results between the hepatic artery and the portal vein branches. Collaterals form between the portal and systemic venous systems, before the sinusoidal bed is reached, as well as in the esophagus abdominal wall and rectum The increased hydrostatic pressure within the portal vein is accompanied by a decrease in the osmotic pressure, since the patient does not ingest sufficient protein and the liver

(1) A.M.A Arch. Surg. 63:379-389 September 1951

fails to produce an adequate quantity of serum albumin. The oxygen content of the portal vein is decreased because of stagnant anoxemia within the portal system. The collaterals shunt 87 100% of the portal blood into the systemic venous circulation

The hepatic artery continues to supply blood to the liver and is the only source of supply when the portal obstruction is far advanced For a long time blood is shunted from the hepatic artery to the portal system by way of the sinusoids and into the hepatic veins by arterial collaterals. The two abnormal arteriovenous communications are from the hepatic artery to the portal vein by way of the sinusoids and from the hepatic artery to the hepatic vein by way of collaterals.

Ligation of the hepatic artery helps in the treatment of portal hypertension because it cuts down the pressure within the arterial tree, permitting the portal venous component to enter the sinusoid at a much lower pressure. It forces arterial collaterals to form and this allows a capillary bed to arise within the liver thereby permitting nourishment of starved hepatic cells Ligation of this artery also slows blood flow and increases lateral pressure and allows more effective consumption of oxygen ratio between pressures in the hepatic arterial branches and portal venous branches are more nearly normal. Ligation of the splenic artery at the same time reduces the volume of blood which may reach the liver, since 25-40% of the portal volume comes from the spleen It also creates a new capillary bed, slows blood flow and increases lateral pressure enlarges the spleen as a reservoir for blood and lowers portal pressure the hepatic arterial capillaries are not collapsed by relatively high portal branches

The liver is not damaged by arterial ligation provided it is done close to the source of supply The operation has been done in 10 patients with advanced cirrhosis of the liver, ascites, and esophageal varices with favorable results although the postoperative period has been too short to evaluate its final effectiveness.

[Seems hard to believe this procedure will not produce more ischemia of the liver but Rienhoff in the following abstract quite independently arrives at similar conclusions.—Ed.]

Ligation of Hepatic and Splenic Arteries in Treatment of Portal Hypertension with Report of Six Cases Prelim inary Report is presented by William F Rienhoff, Jr [2] (Johns Hopkins Univ)

METHOD.—For one week preoperatively and also postoperatively penicillin and streptomycin were given parenterally At laparotomy liver biopsy generally showed typical periportal (Laennec's) cirrhosis. The main hepatic artery was, as a rule, ligated in continuity distal to point of departure of the gastroduodenal artery The splenic artery was also ligated (in two patients) at the point where it leaves the celiac axis.

One of the patients reported on had severe ascites and another extremely severe gastrointestinal hemorrhages All patients reported had prompt and sustained relief. A needle abdominal arteriogram on one, five months post operatively showed no filling of liver vessels, measurement of liver blood flow indicated a lower level of flow as the hepatic artery did not contribute blood to the liver

Pressure within the portal vein is definitely lowered after ligation of the hepatic artery and possibly even more by splenic artery ligation as 30% of portal blood comes from the spleen. About 25% of blood into the liver comes through the hepatic artery under a pressure of 120 mm. Hg as compared with portal pressure of 8-12 mm Hg Yet both empty into a common sinusoidal and capillary bed with the same exit through the hepatic vein. Portal pressure has been shown to rise 1 mm Hg normally for every 40 mm. Hg arterial pressure, and in the cirrhotic 1 mm Hg for every 6 mm Hg Moreover, fibrotic changes in the liver alter blood flow channels from tortuous to simple ones, thereby diminishing blood flow The higher pressure arterial blood flow tends to increase resistance to flow through the liver from the portal vein. Ligation of the common hepatic artery through lowering intra arterial pressure also lowers that in the portal vein.

Utility of penicillin and streptomycin before and after operation supports Ravdin's discovery that ligation of the hepatic artery was fatal in dogs unless penicillin and streptomycin were used to combat anaerobic liver infection. The hepatic and splenic arteries should always be ligated together in portal hypertension. In severe liver injury, the

(2) Bull. Johns Hopkins Hosp 88 368 2 5 April, 1951

hepatic artery might well be ligated for liver hemorrhage.

Selection of Patients for Portacaval Shunts, with Summary of Results in 61 Cases Robert R Linton[3] reports that before use of portacaval shunt operations at Massachusetts General Hospital, *death was due to hemorrhage from esophageal varices* in 45% of cases of cirrhosis and in 71% of cases of Banti's syndrome Since 1945, 61 patients have had portacaval shunt for portal cirrhosis with intrahepatic portal bed block or for Banti's syndrome with extrahepatic block with total operative mortality of 17% Of the 50 patients who survived the shunt operations and followed for one month to six years, none has died of esophageal hemorrhage and 47 are alive and well.

Linton presents the following categories for selection of patients for portacaval shunt. (1) Portal cirrhosis without esophageal varices and ascites is to be treated medically (2) In cirrhosis with ascites and without esophageal varices, where long standing ascites has produced phlegmonous-vascular fibrotic response so that construction of a portacaval shunt is difficult because of inability to isolate the portal or splenic veins, no shunt should be attempted. (3) In cirrhosis with bleeding esophageal varices and ascites (*a*) chronic ascites *should have first stage* operation *in the* form of suture of bleeding esophageal varices done by esophagotomy through a left thoracic approach, followed by measures for correction of protein imbalance, then second stage operation in the form of portacaval shunt and (*b*) acute ascites should be treated with low sodium, high protein and carbohydrate diet, mercurial diuretics and transfusions, then by portacaval shunt only if the ascites is under control. (4) Cirrhosis with bleeding esophageal varices without ascites, absence of which indicates compensated protein metabolism is especially suitable for the shunt operation. (5) Cirrhosis with esophageal varices without bleeding should not have surgery although most patients will probably bleed sooner or later and further studies may indicate that the shunt operation should be done (6) Extrahepatic portal bed block, usually secondary to thrombosis of the portal vein (Banti's syndrome) should have shunt

(3) Ann. Surg. 134 433-443 September 1951.

surgery because repeated esophageal hemorrhages produce chronic invalidism though the liver is essentially normal and surgical mortality is low (3.8%).

Liver function tests have prognostic value and at times indicate need of further preoperative medical measures. Analysis of these liver function tests in relation to operative mortality following 75 operations (not all shunt operations) on 68 patients for bleeding esophageal varices is shown in the table. From this it is deduced that a good

Correlation of Liver Function Tests with Postoperative Deaths in 75 Operations for Bleeding Esophageal Varices

Test	Survivors	Deaths	Mortality
Plasma albumin			
<3 Gm.%	1	5	83%
>3 Gm.%	63	6	9%
Ascites			
No response to medical therapy	5	4	41%
Disappeared on medical therapy	5	2	28%
None	51	5	8%
Prothrombin time			
>4 sec.	25	9	27%
<4 sec.	39	2	5%
Cephalin flocculation			
3+ to 4+	25	11	31%
1+ to 2+	39	0	0
Bromsulfalein retention 5 mg./kg.			
>10%	39	9	19%
<10%	22	0	0
Van den Bergh, >1.0	30	6	17%
Bilirubin, <1.0	32	4	11%

risk patient has 1+ to 2+ cephalin flocculation, plasma albumin content over 3 Gm./100 cc., no ascites, bromsulfalein retention under 10 per cent and prothrombin time within 4 seconds of normal.

The shunt most often used was the end-to-side splenorenal type with preservation of the kidney after splenectomy. Direct portal vein to inferior vena cava anastomosis was also used when technically feasible. Other types of shunts used included superior mesenteric vein to inferior vena cava and inferior mesenteric vein to left ovarian vein or left adrenal vein according to individual

Skeptical Evaluation of Portacaval Anastomosis for Gas trointestinal Hemorrhage in Cirrhosis of Liver Roy Cohn (Stanford Univ) presents three arguments against porta caval anastomosis in liver cirrhosis (1) Since reduced portal blood flow produces liver atrophy, it is more reason able to increase portal blood flow in cirrhosis of the liver than to decrease it by portacaval anastomosis, better selec tion of patients for portacaval anastomosis eliminates those with the greatest liver damage (2) Since the varicose *esophageal vein often exists without portal hypertension* or bleeding (9 of 68 autopsies showed small spleens with no history of bleeding), has no consistent abnormality and therefore does not rupture until pressure far above that of portal hypertension is reached, its relation to portal hyper tension is questionable. Portacaval anastomosis has been most successful when venous pressure is low and the spleen small (3) The erosive factor does not seem to make gastric varices bleed as might be expected, four of the author's patients with gastric varices and no esophageal varices did not bleed. Moreover, there is no evidence that bleeding in nearly half the cirrhotics was due to esophageal varices

In its day, omentopexy was an equally promising cure for cirrhosis Perhaps some of the good resulted from non specific effect of opening and traumatizing the peritoneal cavity, as in tuberculous peritonitis. Since 70% of bleeding cirrhotics will die within a year, portacaval anastomosis *appears to have a narrow field of usefulness* Indications for portacaval anastomosis are (1) inactive cirrhosis, (2) varices demonstrated by x ray, (3) history of bleeding at least once and (4) evidence of portal hypertension in the *form of collateral circulation and enlarged spleen.*

Effect of Portacaval Venous Shunt on Sulfobromophtha lein (Bromsulphalein®) Retention. *D E Preshaw, Alfred* Large and Arthur F Johnson[5] (Detroit), using animals with partial and complete shunts, as well as controls, com pared the ability of the liver to withstand carbon tetrachlo ride poisoning sulfobromophthalein retention being used as an index of liver function.

METHOD.—End to-end (complete) portacaval shunts were con structed in six dogs (series 1) and end to-side (partial) shunts in

(4) Stanford M. Bull. 9:231 236, November, 1951
(5) A.M.A. Arch. Surg 62 801-805 June, 1951

four (series 2) In the latter the portal vein remains open between the shunt and the liver Four controls comprised series 3 At least one month after operation sulfobromophthalein retention determinations were done by Drill's method Five mg of the dye/kg body weight was given intravenously during the fasting state blood specimens were collected 30 minutes later and the dye content was determined Carbon tetrachloride was next given in vegetable oil by stomach tube and sulfobromophthalein retention determined 48 hours later Each week the dose of carbon tetrachloride (which is not cumulative in action) was increased and the experiment repeated Patency of shunts was verified after conclusion of the experiment There were only small differences in sulfobromophthalein retention before carbon tetrachloride poisoning in the three series the averages being 6 1 7 2 and 1.3% respectively in

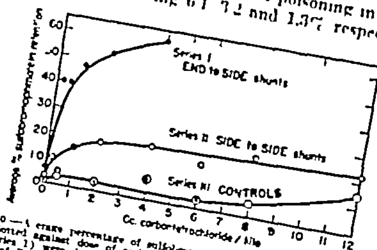


Fig 130 — Average percentage of sulfobromophthalein retention for each group of animals plotted against dose of carbon tetrachloride All six animals with complete shunts (series 1) were dead by time 4 cc carbon tetrachloride/kg had been given (Courtesy of Prohaw D E, et al A.M.A Arch. Surg. 62:801 805 June 1951)

series 1, 2 and 3 These differences may be due to decrease in blood flow through the liver and/or decrease in liver function On the other hand, average retention of sulfobromophthalein at increasing doses of carbon tetrachloride increased rapidly in series 1 animals and early death resulted (Fig 130) Series 2 and 3 animals had a minimal response to carbon tetrachloride poisoning

Since the liver with complete shunt does not tolerate damage as well as the normal liver or the liver with partial diversion of portal flow, it is inferred that the already damaged human cirrhotic liver might be further embarrassed by complete diversion of the portal blood to the vena cava. It is therefore suggested that operations for relief of portal hypertension should not completely shunt the portal blood

away from the liver Side to-side portacaval anastomosis or splenectomy with end to-side splenorenal anastomosis satisfies these requirements

Autogenous Vein Grafts in Splenorenal Anastomosis. Louis M Rousselot[6] (New York Univ) describes an operation for reducing venous pressure in the portal system and thereby diminishing the threat of fatal hemorrhage from esophageal varices in portal hypertension. Combined splenectomy and splenorenal shunt is preferred to anastomosis

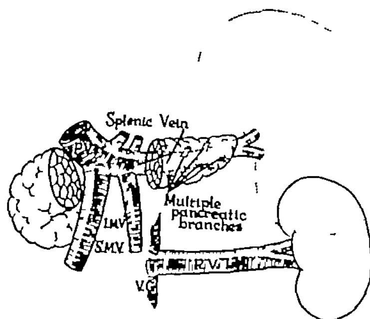


Fig 131 —Drawing of splenic vein showing short segment f main vein between tail of pancreas and bifurcation of vein also multiple pancreatic branches (Courtesy of Rousselot, L. M. Surgery 31 403-410 March, 1952)

of portal vein to inferior vena cava Use of a vein graft from the splenic vein to the renal vein obviates time-consuming and dangerous mobilization of the splenic vein in the pancreatic tissue (Fig 131) and angulation of the splenic vein over the tail of the pancreas and tension on the suture line are prevented

TECHNIC.—A segment of the left superficial femoral vein, usually 5-6 cm. long, is removed and stored in heparin solution while the abdominal procedure is continued. The spleen is mobilized by a second operative team its artery is ligated and the secondary splenic veins are traced to the bifurcation of the main splenic vein trunk

(6) Surgery 31 403-410 March, 1952.

The splenic vein is cut obliquely and an end-to-end anastomosis is performed with the vein graft. An oval opening is cut in the side of the left renal vein and the end of the vein graft sewed to the side of the renal vein.

The shunting operation was performed on seven patients, in six of whom the graft was placed between the splenic vein and renal vein and in one between the superior mesenteric vein and renal vein. The only patient to receive anticoagulant therapy died on the 13th postoperative day of dicumarol® poisoning. Of the six who survived, five have had excellent clinical courses for 3-12 months. One patient had a recurrence of massive hematemesis.

Surgical Management of Postsplenectomy Bleeder with Extrahepatic Portal Hypertension. Arthur H. Blakemore and Hugh F. Fitzpatrick[7] (Presbyterian Hosp., New York City) state that of 40 patients with portal hypertension due to extrahepatic portal block in which some type of portacaval shunt was achieved, 15 had had recurring gastrointestinal hemorrhage after splenectomy. In all patients the obstruction site was the portal vein itself, but in only one was the vein suitable for anastomosis. In the other 14 postsplenectomy cases the splenic vein was used in 3; lesser veins were used in most of the postsplenectomy bleeders. In 25 cases in which the spleen was intact, splenorenal shunt followed splenectomy.

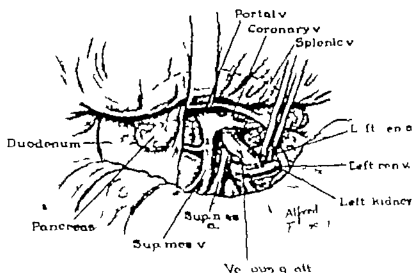
There were 3 postsurgical deaths and in the remaining 37 cases 2 follow-up deaths. Hemorrhage was the cause of death, and the shunts were proved to be occluded in each case. Of 14 patients followed in whom the spleen had been removed at a previous operation, there were 10 failures as compared with 5 failures in 23 cases in which the spleens had been intact. In the latter five failures the nonsuture vitallium tube had been used for establishment of anastomoses in four cases. There was only 1 failure in 15 cases in which suture anastomosis was used to establish splenorenal shunts.

It is usually impossible to utilize collateral veins within the hepatoduodenal ligament, the superior mesenteric or the inferior mesenteric veins for direct anastomosis with the vena cava. Vein graft bridging, using a segment of the

(7) Ann. Surg. 154:420-432, September, 1961.

superficial femoral vein, between the splenic vein stump and the renal vein, has been successful.

TECHNIC.—The ligament of Treitz is cut, the jejunum and duo-



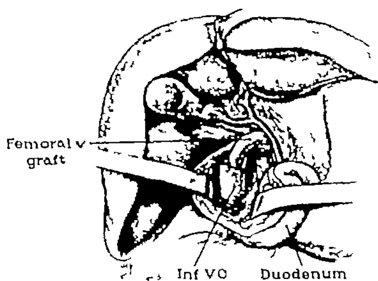


FIG 132 (top).—Completed shunt; note large size of splenic vein at junction with coronary vein.

FIG. 133 (bottom).—Completed superficial femoral vein graft, end-to-side from sizable collateral portal vein in hepatoduodenal ligament to inferior vena cava; note relation of aberrant portal collateral to common bile duct and dilated cystic vein.
(Courtesy of Blakemore A. H. and Fitzpatrick H. F: Ann. Surg. 134:420-432, September 1951.)

denum are reflected medialward the superior mesenteric artery is identified, and by introducing a finger directly upward along the lateral border of the artery a point for incision along the inferior

border of the pancreas through a gastrocolic approach can be identified. The pancreas is reflected upward and the superior mesenteric artery followed up to the point of crossing by the splenic vein. A segment of the splenic vein is exposed for end to-side anastomosis to the superficial femoral vein. The renal vein is felt just below the point of origin of the renal artery from the aorta. The point of anastomosis of the vein graft end to-side is made at a site proximal to the origin of the adrenal, spermatic or ovarian veins (Fig. 132)

If it is impossible to anastomose the stump of the splenic vein to the renal vein a vein graft can be used to bridge the distance from an accessory collateral vein in the hepatoduodenal ligament to the vena cava (Fig 133)

The critical period for thrombotic occlusion of splenorenal or other types of shunts using veins of lesser size is during the immediate postoperative healing period of the anastomosis site Continuous regional heparinization is a safe method for control of blood clotting Fine plastic catheters placed in the superficial femoral vein reach to the inferior vena cava and in the inferior mesenteric vein, to the splenic vein. Portal blood and portal pressures can thus be secured for comparison with extremity blood. Patency of the shunt can be established by noting a higher oxygen content of a vena cava sample compared with a sample from an arm vein.

Results of Splenectomy Follow up Study of 140 Consecutive Cases was conducted by Edward M Miller and Albert B Hagedorn[9] (Mayo Clinic) from 1942 to 1944 Of these patients, 38 had congenital hemolytic icterus. Accessory spleens were removed in five One hospital death followed intraperitoneal hemorrhage from the splenic bed. Follow up revealed that of 29 patients, none died or had recurrence of preoperative symptoms Forty-seven patients had essential thrombocytopenic purpura Accessory spleens were removed in seven. One hospital death of a girl, 2, with extremely low platelet count resulted from cerebral hemorrhage 2½ months after splenectomy Follow up of 35 patients revealed a history of further episodes of either epistaxis or petechiae in 4 but in no instance were these symptoms severe of 3 deaths in this group 1 resulted from Albers-Schönberg disease with myeloid metaplasia 2½ years after surgery another of chronic myelogenous leukemia 2½

(9) Am. Surg. 134 815-8 1 November 1951

superficial femoral vein, between the splenic vein stump and the renal vein, has been successful.

TECHNIC.—The ligament of Treitz is cut, the jejunum and duo-

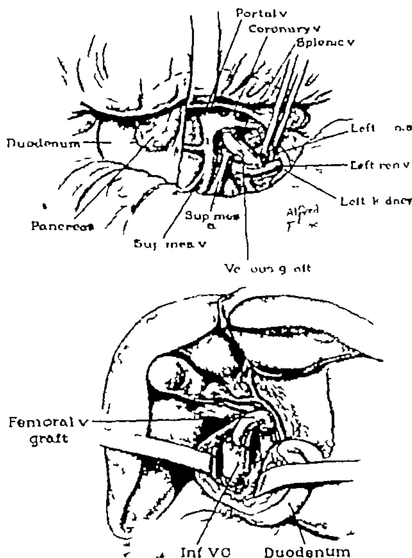


Fig 132 (top).—Completed shunt; note large size of splenic vein at junction with coronary vein.

Fig. 133 (bottom).—Completed superficial femoral vein graft, end-to-side from sizable collateral portal vein in hepatoduodenal ligament to inferior vena cava; note relation of aberrant portal collateral to common bile duct and dilated cystic vein. (Courtesy of Blakemore, A. H. and Fitzpatrick, H. F. Ann. Surg. 134:420-432, September 1951.)

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(9) Ann. Surg 134 816-821 November 1951

months postoperatively, and the third of unknown cause. The others were healthy Forty five had Banti's disease or congestive splenomegaly Accessory spleens were found in 13 Of four hospital deaths, two resulted from intraperitoneal hemorrhage and two of hemorrhage from ruptured esophageal varices. Of 33 patients followed up 17 were living and 7 of them had had further episodes of hematemesis. The most common cause of death was massive gastrointestinal hemorrhage

Five patients had acquired hemolytic anemia, none had accessory spleens or died in the hospital. Of four followed, two were well with no recurrence of symptoms, one had lymphosarcoma and one had recurrence of icterus. One patient died four years after splenectomy of chronic myelogenous leukemia Splenectomy was performed in five cases for indeterminate splenomegaly Microscopic diagnoses showed Hodgkin's disease, reticuloendothelial hyperplasia, regressing hemangioma of the spleen Banti's disease and a myeloid metaplasia suggestive of future myelogenous leukemia There were no accessory spleens and no hospital mortalities. The patients with reticuloendothelial hyperplasia and Hodgkin's disease died The one with hemangioma did not. The patient with Banti's disease remained alive after splenectomy whereas the one with myeloid metaplasia died of chronic myelogenous leukemia

The study indicates that splenectomy will be curative in most instances of congenital hemolytic icterus and primary thrombocytopenic purpura In nearly half the patients with acquired hemolytic anemia of the primary type splenectomy produces sustained remission. Results of splenectomy in congestive splenomegaly are discouraging

The high incidence of accessory splenic tissue demands careful exploration of the entire peritoneal cavity at laparotomy Splenectomy is justifiable as a diagnostic measure in splenomegaly when bone marrow studies have excluded agnogenic myeloid metaplasia

Agnogenic Myeloid Metaplasia of Spleen, according to K. F M Uttley [1] is not as rare as commonly believed and has been described under a variety of names. The disease is chronic splenomegaly and myeloid and megakaryocytic

(1) New Zealand M J 50 102 108 April 1951

transformation of the spleen are evident. Anemia is frequent and is ordinarily associated with an unusual number of nucleated red cells in the blood, occasionally there is a polycythemia Hepatomegalia may occur, but fibrosis or sclerosis of the marrow is more common. Occasionally changes in white cells suggest leukemia but are atypical Changes in bones and type of anemia are variable In the two cases discussed hemorrhagic tendencies were seen and there were increased numbers of abnormal types of platelets. The condition must be distinguished from myelogenous leukemia. Its exact nature is unknown but it is believed to be a compensatory mechanism of extramedullary hematopoiesis depending entirely on degree of myelosclerosis and fibrosis. Its relation to leukemia refractory anemia and such diseases as Cooley's anemia and erythroblastosis fetalis (in which erythroblastic anemia and myelosclerosis may occur) still remains to be determined, but it is important to establish diagnosis to avoid splenectomy or irradiation of the spleen. Treatment is purely symptomatic

Each of the patients discussed had splenomegaly without hepatomegaly or lymph node enlargement. They had subleukemic white count with nucleated red cells and increased and abnormal platelets. One patient had a slowly progressing illness as the spleen was already enlarged when she was first seen in 1946 The other had had splenomegaly for 2½ years and died in severe anemia. She had a marked hemorrhagic tendency and, at one time, a mild degree of polycythemia The living patient with 12.5 Gm. hemoglobin is not anemic Neither patient had any noticeable bone abnormality but full skeletal examination was not possible in either The prothrombin time was moderately prolonged in both but bleeding tendencies in the woman who died was not related to prothrombin time

Splenectomy in Leukemia and Leukosarcoma. According to John H. Fisher C Stuart Welch and William Dameshek[2] (Tufts College) splenectomy can be beneficial in a few especially selected cases of leukemia and leukosarcoma In 18 patients 11 with leukemia and 7 with leukosarcoma splenectomy was done only after long observation under ordinary forms of therapy some cases were experimental.

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(2) New England J Med. 246 477-484 Mar 27 1952.

Nearly all patients had had roentgen therapy over the spleen to the limit of tolerance

Hypersplenism, as manifested by cytopenic disturbances alone, was found in seven patients. In five patients a severe hemolytic anemia constituted the indication for surgery In four patients hemolytic anemia was combined with cytopenic hypersplenism. In two patients the spleen was removed because of its large size and painful symptoms, one of these had concomitant thrombocytopenia with clinical purpura. In the leukemia group, hemolytic anemia was more common than cytopenic hypersplenism. Pancytopenia was more common than hemolytic anemia in patients with leukosarcoma.

In hypersplenism, escape of mature cells is blocked and maturation of blood cell precursors in bone marrow and hemolysis of red cells are prevented Removal of hyperactive spleen may relieve hemolytic or cytopenic disturbances

For best results in splenectomy in hypersplenism, the bone should be hyperplastic, but such is not the case in leukemia and leukosarcoma. Nevertheless improvement after splenectomy requires enough blood cell precursors in the form of nucleated red cells and megakaryocytes to control hemolytic anemia or severe cytopenia. If transfusion will provide that control, splenectomy may be indicated Diminished megakaryocytes or nucleated red cells in the bone marrow is a contraindication. An extremely large painful spleen may be an indication for splenectomy

In 14 cases, hypersplenism in leukemia or leukosarcoma was diagnosed preoperatively and the spleen removed In four patients neoplastic disease was not diagnosed and leukemia or leukosarcoma was found after surgery

Benefit prolonged one to five years after splenectomy was seen in eight patients three patients had temporary benefit for three months to one year five patients had no benefit, and two died in the hospital after surgery one of thrombocytopenic purpura and another of generalized thrombosis with thrombocytosis. Control of hemolytic anemia and relief of cytopenias followed most splenectomies.

ACTH is useful in controlling hemolytic anemia in hypersplenism and should be tried before resort to splenectomy

Indiscriminate use of splenectomy is not advocated in leukemia or leukosarcoma, it should only be considered in hypersplenism or in rare instances of extremely bulky and painful spleen

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STOMACH AND DUODENUM

Hypertrophic Pyloric Stenosis, according to Harold F Flanagan[3] (Children's Hosp., St Paul), is the commonest surgical condition in the first three months of life Of 73 infants treated surgically during 1945-50, pyloromyotomy was done on 72. Of these, 87% were boys and 37% first born. There was no history of a sibling having the same disease and no definite seasonal incidence Vomiting the presenting symptom in all cases, had been present since birth, increasing in frequency up to age 4 or 6 weeks. All infants had lost weight and were constipated. Visible peristaltic waves were seen in all, and an abdominal mass was definitely palpated in 31 questionably palpated in 16 and not felt in 26 At surgery, a tumor was found in 72 Dehydration and alkalosis are serious problems In most cases x ray is not necessary for diagnosis It was the diagnostic medium in one case in this series The characteristic x ray sign is a long narrow string like shadow only 1 2 mm. wide at the pylorus.

Differential diagnosis must include pylorospasm, vomiting due to infection, intracranial injuries, esophageal atresia and stenosis congenital obstruction of the first part of the duodenum, extrinsic intestinal obstruction, and esophageal chalasia

Preoperative treatment should be aimed at overcoming fluid loss, replacement of the liver glycogen, and establishment of a normal electrolyte balance, including potassium The most satisfactory hydration and replacement fluid was found to be a mixture of Butler's solution and 5 or 10% glucose in water The Fredet Ramstedt type of pyloromyotomy was used in all cases. Postoperatively fluid balance is important and when feeding has been effective

Grossly there is a smooth shining mass, usually carti

(3) Minnesota Med. 34 957-963 October 1951

laginous in consistency, at the pyloric antral region. It is spindle shaped and 2-3.5 cm long and 1.5-2 cm. wide, with a wall thickness of 0.5-0.8 cm The muscular coat of the entire stomach is thickened to some degree Microscopically the circular smooth muscle layer is greatly hypertrophied *and the number of smooth muscle fibers is actually increased* Sections of the mucosa reveal edema and leukocytic infiltrations.

There were eight surgical and eight medical complications The duodenum was perforated at operation in five patients, but all recovered after closure of the perforation. Postoperative hemorrhage was seen in two both of whom recovered. one after a transfusion. Reoperation was necessary on one infant, five weeks after the first operation, for further division of the muscle fibers Three infants had pneumonia, one of whom died, a mortality rate of 1.37% Three had severe diarrhea and two an upper respiratory tract infection with otitis media.

Fate of Tumor in Infantile Hypertrophic Pyloric Stenosis George Armitage and J A Rhind[4] (Gen'l Infirm. at Leeds) report a case of peptic ulcer following gastrojejunostomy for pyloric stenosis, which is the twelfth to appear in the literature

Woman 41, had posterior gastrojejunostomy in 1909 for pyloric stenosis. In 1935 she had vague symptoms of indigestion and pain in the right iliac fossa. An appendectomy was done but she continued to have periodic bouts of indigestion and abdominal pain until 1950 when an acute abdominal condition developed. At an emergency laparotomy a perforated jejunal ulcer was found at the duodenojejunal flexure. *There was gross thickening of the pyloric* canal, the appearance being identical with that seen at operation on infants with congenital pyloric stenosis. The patency of the pylorus was doubtful and partial gastrectomy with precolic gastrojejunostomy was performed The pyloric portion of the stomach measured 5 cm in the line of the greater curvature and 2.5 cm. in the line of the lesser curvature, and there were mucosal atrophy and minimal *fibrosis of the muscle.*

The pyloric tumor remains unchanged in some but not all patients Obstruction may play a role in producing the ulcers Studies have shown that Ramstedt's operation will cure the stenosis Many believe that if an infant can be kept alive through the critical period a high percentage of

(4) Brit. J Surg 39 39-42 July 1951

cures will be obtained by medical therapy Others believe that without treatment peristaltic waves will soon pass over the pyloric canal and normal motility be reinstated

[The risk involved in the Fredet Ramstedt operation is so slight that there should be no place for nonsurgical treatment if a diagnosis has been made —Ed.]

Relation of Gastric Secretion to Events Following Pyloric Obstruction. James S Clarke, Harry A. Oberhelman, Jr, Shirl O Evans and Lester R Dragstedt[5] (Univ of Chicago) conducted experiments on dogs to study the effect of a gastric fistula water drinking, saline drinking, parenteral administration of dextrose in water and of saline, vagus section and antrum resection on events following interruption of the digestive tube at the pylorus. Water given by mouth in pyloric obstruction caused an increased fluid loss by vomiting and an increased chloride loss with resulting severe alkalosis Saline by mouth was much less harmful in that it decreased the net water loss from the stomach though it did not seem to affect the chloride loss much Dextrose in water parenterally prolonged survival, but water and chloride loss in the gastric lumen continued. Saline parenterally did not prolong survival and increased the gastric water and chloride loss greatly during the period elapsing from its withdrawal to death

Water in the stomach and antral distention acted as a mild stimulus to gastric secretion, thus explaining the water and salt loss during ingestion of water In the water drinking experiments the excessive chloride loss was diminished by making a gastric fistula, and both water and chloride loss were reduced by antrum resection and vagus section. The oral intake of saline did not increase water and salt loss probably because there was a balance of electrolytes between the extracellular fluids and the contents of the gastric lumen.

Account of Gastroduodenal Anatomy of Importance in Palliative Gastric Resection. The aim of palliative gastric resection is to eliminate immediate postoperative complications in the ulcer region by leaving the duodenum untouched. A distal resection border is created through the canalis and, to ensure good late results, the mucosa down to the pylorus is excised and the remaining muscle of the

(5) Ann. Surg. 135 433-440 April, 1952.

canalis invaginated. Postoperatively the ulcer usually heals, however, perforation or complications due to suture insufficiencies sometimes occur In an attempt to relate these failures to the anatomy, particularly the blood supply, of the region, Sten Grettve[6] (Univ of Uppsala) performed dissections and studied vascular injected specimens. He found that the well developed arterial and venous networks in the submucosa of the duodenum and gastric canalis, which are directly connected through the pylorus, account for the exceptionally good collateral supply existing over long distances in the gastroduodenal wall. At palliative gastric resection these networks are always extirpated with the mucosa. The remaining muscle cuff has a poor collateral circulation because it has no anastomoses of larger caliber

To diminish the risk of suture insufficiency, optimal blood supply *must be maintained. The muscle cuff should not be* mobilized to an extent greater than necessary, and the already poor circulation should not be further deteriorated by invagination sutures which put tissues under high tension A single suture line without tension is safer than two rows of sutures with tension To reduce strain on both the closure and the remaining ulcer an enteroanastomosis is advisable

Though palliative gastric resection is not advocated as a routine method, as a planned procedure it may offer a solution in selected cases

Prolapse of Gastric Mucosa into Duodenum. I. W Kaplan and R. M. Shepard[7] (Louisiana State Univ) report on 4 cases to bring the total surgically confirmed to 44. The cause and mechanism are not definitely known The lesion may be mechanical, based on hypermotility of gastric mucosa. It may be congenital or caused by any condition that produces abnormal motility and in time so loosens the mucosa from the submucosa that prolapse can occur On operation, the prolapsed part of the gastric mucosa resembles a loose collar of redundant hypertrophied mucosa.

The condition is more common in older persons, occurring mostly in the 4th and 5th decades The clinical picture varies so that definite diagnosis cannot be based on symp-

(6) Acta chir scandinav 103 52-60 1952
(7) J A M A 147 554 560 Oct. 6 1951

although duodenal diverticula are common they rarely cause symptoms Etiology of the lesion is not known but many hypothesize a congenital weak point or area of lowered resistance in the bowel with gradual ballooning on the same mechanical basis as in all pulsion diverticula The diverticula were on the mesenteric side in 22 of 25 patients brought to surgery Over 33% had concomitant diverticulosis of the colon one had diverticulosis of both jejunum and colon The diverticulum is true if all layers of duodenum are found in its wall and false if one or more coats are missing Average age of the 25 patients was 50

Symptoms of duodenal diverticula follow no definite pattern and often there are none, most common are pain and flatulence, discomfort often continues for years with some pattern of periodicity Preoperative diagnosis is invariably based on an upper gastrointestinal barium series. Careful search must be made for other pathologic states possibly responsible for the symptoms Diverticula can indispose the patient as a result of stasis and distention, inflammation hemorrhage and sometimes malignancy Medical treatment including ulcer management alkalis, antispasmotics, low fat and colitis diet is advocated before surgery is considered It is indicated for less than 5% of patients and results emphasize the difficulty in selection for surgery

Excision of the diverticulum is the surgical treatment of choice Technic varies with location of the sac and its proximity to vital structures Those on the anterior surface of the duodenum are no problem. Those on the posterior surface of the second portion of the duodenum are removed after approach from the lateral border with reflection of the duodenum to the left Diverticula of the third portion are removed by turning the duodenum and pancreas upward and over

Of 25 diverticula cases 20 were in the second, 7 in the third and 1 in the first portion of the duodenum. In six instances diverticula were intimately associated with the pancreas, three of them embedded in it. In one case the sac was near the distal portion of the common duct and four had double sacs

Surgical results were excellent in 15 patients 4 had some improvement, and 6 failures (including 2 deaths) The deaths

resulted from pancreatic enzyme leakage and pancreatitis In only 17 patients were results based purely on diverticulum removal. Of these, results were excellent in 9, fair in 3 and poor in 5

[All surgeons and gastroenterologists will agree that duodenal diverticula seldom produce symptoms. The x-ray demonstration of the presence of a diverticulum does not in itself constitute an indication for its removal.—Ed.]

Modern Treatment of Massive Hemorrhage of Peptic Ulcer Origin. Burrill B Crohn and Henry D Janowitz[9] (Mount Sinai Hosp, New York City) discuss massive hemorrhage that is accompanied by shock and decrease of red blood cell count to 3 000,000 or less and hemoglobin content to below 50% Peptic ulcer hemorrhage is a complication in about 25% of ulcer cases, with growing incidence in recent decades Duodenal ulcer incidence is four times that of gastric ulcer hemorrhage from each occurs in the same ratio Initial hemorrhage is often the most severe and causes the greatest mortality Subsequent massive hemorrhages may occur in 60-74% of patients but are less apt to threaten life Hematemesis is more common in gastric, melena in duodenal ulcers Arterial hypertension has little effect on hemorrhage and none on mortality

Medical mortality with conservative therapy of all grave hemorrhage originating in ulcer is 6.9% with only massive hemorrhage tabulated, conservative death rate is 10 7% massive hemorrhage after 45 has a 15% fatality rate rising to 50% in the seventies Mortality of hemorrhage from gastric ulcer is twice that from duodenal ulcer Mortality among men exceeds that among women.

Results of feeding during hemorrhage as advocated by Meulengracht show a 2.5% mortality rate This includes some mild hemorrhages, and Meulengracht feeds less liberally during the critical period—the first 72 hours. After that feeding has little significance With more liberal diet restricted to patients with massive hemorrhage mortality rates are better than over all rates with the old starvation and conservative measures

Use of fluid and blood in patients with grave hemorrhage to overcome shock, replace excessive blood loss or prepare for surgery is well advocated whether directly reflected in

(9) Gastroenterology 19 404-422 December 1951

lower mortality rates for hemorrhage or not. Anoxia from anemia is damaging to the myocardium and may induce coronary thrombosis.

Amphogel intragastric drip, gastric suction and administration of Gelfoam and thrombin by mouth have not been much used and evaluation is difficult.

Prognoses in individual cases are difficult If the initial massive hemorrhage ceases within 72 hours, prognosis is excellent If initial hemorrhage is followed by recurrent bleeding, prognosis becomes increasingly poor Blood urea estimates on successive days have been advocated as an index of gravity of hemorrhage, but blood urea is indicative but not infallible for prognosis The general hypothesis is that the rise in blood urea content is due first to prerenal azotemia, then rapid breakdown of body tissues and finally to rapid absorption of digested blood from the upper intestinal tract. Shock and resulting diminished circulation through the renal bed in itself increases accumulation of nitrogenous wastes in the blood, urea level is thus a measure of circulatory failure

Surgery has been more often used in massive hemorrhage therapy Indications for early surgery follow (1) Diagnosis of ulcer based on previous history or x ray studies, although in some cases hemorrhages have been induced during x ray examination. (2) Hemorrhage in persons over 45 (3) Hospitalization within 48 hours of onset of massive hemorrhage, rapidly recurring grave hemorrhage, hemorrhage lasting longer than or tending to recur within 72 hours, or the need for 1 500 cc blood daily (4) Previous grave hemorrhage and now a second massive hemorrhage (5) Type of bleeding whether hematemesis (with its higher mortality) or melena (6) Degree of severity (red cell count below 3 000 000 and hemoglobin content below 50%) Subtotal gastrectomy with excision of the gastric or duodenal ulcer is the operation of choice When removal of the ulcer bed is difficult, exclusion operations may have to be done.

Mortality rate for surgery within 48 hours of massive hemorrhage from peptic ulcer in 746 reported cases ranged from 0 to 33% with gross average 10 5% If surgery is delayed until hemorrhage has continued two or three weeks with repeated shock episodes and progressive anemia, the

mortality rate ranges from 4 to 54% and averages 24 4%

Emergency Diagnosis of Upper Digestive Tract Bleeding by Roentgen Examination without Palpation (Hampton Technic) Harvey C Knowles Benjamin Felson, Nathan Shapiro and Leon Schiff[1] (Univ of Cincinnati) describe a safe and valuable technic of early roentgen examination useful in finding the source of upper digestive tract bleeding during the acute episode of hemorrhage The technic determines the source of hemorrhage as a means for definitive treatment as a help in selecting the surgical approach and as an index of prognosis

TECHNIC.—The patient is lifted from stretcher or bed to x ray table in supine position by means of a draw sheet. After receiving about 2 oz. of a barium mixture (equal parts barium and water), he is turned on his right side, then back to the supine position to distribute the barium over the entire stomach wall. Multiple non pressure spots are then taken of the stomach. The patient is again placed on his right side until barium is seen to enter the duodenal bulb, he is returned to the supine position and rotated toward the left. In this position the gas bubble rises into the antrum and bulb, producing a double contrast effect. By variance of degree of rotation, the bulb can usually be projected to the left of the spine free from other barium shadows, and appropriate spot films can be obtained. The patient is placed in the prone position with the left side elevated and more spot films are taken. The remainder of the barium is given and the stomach and duodenum again studied. The esophagus is examined with a thick barium mixture. Bucky right lateral and right anterior oblique films complete the examination The entire procedure should take 30 minutes.

The procedure was performed on 80 patients aged 17 72 In 63 cases 66 significant lesions were found 34 were proved by operation or autopsy 28 appeared obvious on follow up gastrointestinal examination with palpation and 4 seemed certain from the clinical course Diagnosis by the Hampton method was correct in 86% There were no false positive diagnoses In three cases the examination was technically unsatisfactory There were nine diagnostic errors by the Hampton method. Diagnosis could not be established in 17 cases.

The value of the technic has been great as an aid in diagnosis and therapy of acute upper gastrointestinal bleeding No apparent harm resulted in any of the cases. The procedure is not intended to replace the routine gastrointestinal

(1) Radiology 58 534-541 April, 1952.

examination, which is always indicated at a suitable interval, about 14 days, after cessation of bleeding

Effect of Various Surgical Procedures on Acidity of Gastric Contents of Ulcer Patients Douglas A. Farmer, Chester W Howe, William J Porell and Reginald H. Smithwick[2] (Boston Univ) found it to be greater in patients with duodenal ulcers than in normal persons after stimulation by insulin, beef broth and histamine (Fig 134) The difference was greatest under fasting conditions Hydrogen ion concentration in the gastric contents was greater in the patients than in normal persons The observations in patients with gastrojejunal ulcers after various operations for duodenal ulcer were similar to those in untreated patients with duo-

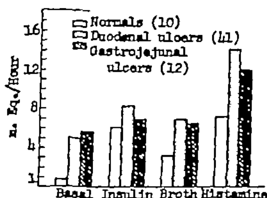


Fig 134.—Acidity of gastric contents. (Courtesy of Farmer D A., *et al* Ann. Surg 134 319-331 September 1951)

denal ulcers, except that the quantity of free acid was slightly lower

Resection of an estimated 50% of the stomach combined with vagotomy greatly reduced both the quantity of free acid and hydrogen ion concentration. The effect of this combined procedure and of subtotal resection alone on both was more striking than that after vagotomy plus posterior gastroenterostomy The effect of removal of over half the stomach combined with vagotomy is no greater than that of removing an estimated 50% with resection of the vagus nerves. Removal of an estimated third of the stomach combined with vagotomy was considerably less effective

The clinical results after removal of 50% of the stomach

(2) Ann. Surg. 134:319 331 September 1951

combined with vagotomy are superior to those after more radical resections with or without vagotomy Early results suggested that 50% resection with vagotomy may be as effective protection against ulcer diathesis as more radical subtotal resection.

If vagotomy combined with posterior gastroenterostomy gives adequate protection against ulcer diathesis it is probably because of some effect other than that on gastric acidity alone The acidity after this procedure is often within the range found in patients with gastrojejunal ulcers following posterior gastroenterostomy or subtotal gastrectomy

The greatest drawback to procedures involving resection of the vagus nerves is the hazard that the denervation may not be complete in a small but definite per cent of cases. Although there were no instances of regeneration of the vagus nerve in patients followed three years, it is a possibility

Experimental Hyperfunction of Gastric Antrum with Ulcer Formation. Lester R Dragstedt, Harry A. Oberhelman, Jr., and Curtis A. Smith[3] (Univ of Chicago) prepared isolated total pouch dogs by transecting the stomach at the cardia and pylorus. The esophagus was anastomosed to the duodenum the upper and lower ends of the stomach were closed the vagus nerves were cut and the gastric secretions were collected with a plastic cannula In such animals only a meager amount of gastric juice is produced in 24 hours since both the nervous and antrum phase of gastric secretion have been eliminated Transplantation of the antrum of the stomach into the side of the transverse colon as a diverticulum profoundly increased gastric secretion (Fig 135) This increase is due to the excessive or long-continued production of a humoral agent, gastrin, since it occurs if all the nerve connections between the antrum and stomach have been divided In some animals, perforating gastric ulcers developed in the vagotomized total stomach pouch.

To determine if the hypersecretion of gastric juice induced by transplantation of the antrum into the colon could cause an ulcer to develop in the stomach in the presence of the neutralizing effect of food and the alkaline duodenal content intestinal continuity was re-established in 10 ani

(3) Ann. Surg. 134:332-345 September 1951

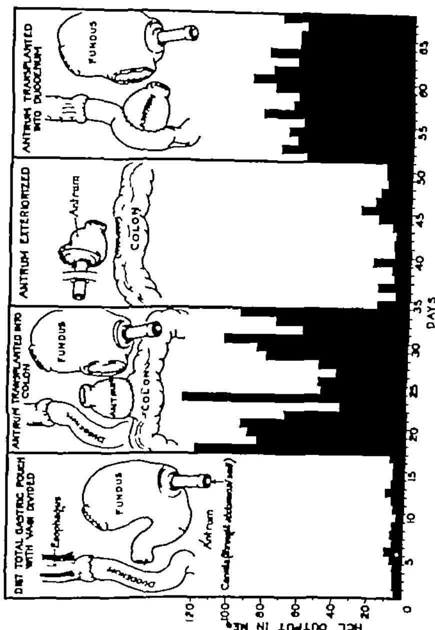


Fig. 136 —Comparative effect of antrum transplantation into colon and duodenum on HCl output of stomach. (Courtesy of Dragstedt, L. R. et al Ann. Surg 134 332 345 September 1951)

mals by gastroduodenostomy utilizing the first portion of the duodenum and in 10 by gastrojejunostomy The former resulted in formation of stoma ulcers in 20% of the dogs, whereas the latter had this effect on 80%

In man, gastrojejunal ulcers seldom develop after gastro enterostomy or gastric resection for gastric ulcer or for car cinoma near the pylorus, but are seen as a complication of

surgery for duodenal ulcer There is hypersecretion of gastric juice both in the fasting stomach and in response to ingestion of food in most patients with duodenal ulcers, it probably brings about the gastrojejunal ulcers Gastric secretion is either normal or reduced in patients with gastric ulcer or pyloric carcinoma.

Whereas hypersecretion of gastric juice of antral origin with resultant ulcer formation can be produced in animals, evidence is not yet available to indicate that the hyper secretion characteristically found in patients with duodenal ulcer is due to antrum hyperfunction, although this possibility should be kept in mind Evidence that the hypersecretion in most such patients is not of antral origin and is not due to hyperactivity of this phase of gastric secretion is that simple removal of the antrum at partial gastrectomy was relatively ineffective in prevention of gastrojejunal ulcerations. Elimination of the nervous phase of gastric secretion by complete vagotomy has been found to abolish the hypersecretion of most, if not all, patients with duodenal ulcer

The relatively few stoma ulcers that appeared after gastroduodenostomy as compared with the high incidence and large size of those that appeared after gastrojejunostomy indicate a much greater resistance of the duodenal as compared with the jejunal mucosa

[These clean-cut experiments demonstrate the value to the surgeon (Dragstedt) of a training in physiology.—Ed.]

Segmental Gastric Resection for Peptic Ulcer Method Permitting Restoration of Anatomic Continuity Owen H. Wangensteen[4] (Univ of Minnesota) describes an operation in which the antrum of the stomach is allowed to remain and a small segment of the fundus beyond the esophagus, constituting not more than 10% of the entire stomach or 15% of the acid secreting area, is preserved. This procedure when accompanied by adequate pyloroplasty, is satisfactory for duodenal ulcers as well as gastric ulcers in the stomach proximal to the antrum. It protects the dog against ulcer provoked by histamine in beeswax. The operation is particularly adaptable to large and difficult supraduodenal ulcer craters on which the Billroth I operation is not pos-

(4) J. A. M. A. 149 18 23 May 3 195

sible and the Billroth II operation would carry considerable hazard.

TECHNIC.—A midline supraumbilical incision with a median *extrapleural sternotomy* gives the best exposure. The lateral avascular ligament of the duodenum is divided, the duodenum and antrum are drawn into the operative field, and a longitudinal slit is made through the pylorus and extended into the duodenum and antrum. Closure of the incision is begun by approximating the two far points with interrupted fine silk sutures.

All of the stomach is resected except the antrum and enough of the fundus for anastomosis to the antrum. Anastomosis is done by combined closed and open technics. A row of interrupted silk sutures is placed behind and tied. The clamps are turned over, and the corner angles are dealt with by placement of two sutures anteriorly at either end of the anastomosis, which are tied after the clamps are withdrawn. The pouch is opened, and a few mucosal stitches are placed. An indwelling duodenal tube, which was pulled back into the esophagus during operation, is now pushed through the pyloroplasty well into the duodenum. A few mucosal stitches are placed anteriorly, and another row of sutures in the serosa complete the anastomosis anteriorly. The anastomosis is rotated to permit placing of a few stitches in the posterior row from the outside. The lesser curvature is attached by a few sutures to the hepatic margin of the hepatoduodenal ligament.

The only contraindication to this operation is an antral ulcer. A disadvantage is the possible injury to the esophagus by the bile. The operation is useful in duodenal ulcers with bleeding because direct treatment to the bleeding point is possible.

The operation has been done 60 times with one hospital death. No recurrences have been seen after more than a year. Achlorhydria to histamine was found in 65% of patients, which is as common as after the three-quarter Billroth II resection. The stomach pouches retain barium for 30 minutes as compared with 10 minutes after the Billroth II procedure. Many patients have the dumping syndrome during early convalescence. The patients do not lose much weight, and in none has anemia developed. Early results of the operation compare favorably with results of the more conventional modes of gastric resection.

Safeguards in Gastric Resections for Duodenal Ulcer. *Frederick P. Ross and Richard Warren*[5] (Veterans' Admin. Hosp., West Roxbury, Mass.) review results of 241 operations on 236 patients with severe and intractable duodenal

(5) New England J. Med. 245: 475-481, Sept. 27, 1951.

ulcer Gastroenterostomy was done five times with a 20 per cent mortality This operation will always have a small place in treatment of elderly, cachectic poor risk patients in whom the problem is cicatricial obstruction rather than any current activity of the duodenal ulcer Vagotomy was done on 32 patients, with a recurrence rate of almost 30 per cent. This operation is indicated only for marginal ulcer when an adequate resection has been carried out

Extensive partial gastric resection, which is the operation of choice, was done 200 times, with three deaths Thirteen resections were carried out as urgent or emergency procedures for control of massive bleeding None of the deaths occurred in this group Factors of importance in this operation, other than technical problems, are adequate preparation with diet, aspiration and administration of fluid and blood as needed, proper time for operation, competent anesthesiologist and alert postoperative care A week or more of the strictest medical management will reduce the inflammatory reaction and make surgery easier

Criteria for adequate gastric resection include removal of essentially all the lesser curvature by resecting well above the left gastric artery removal of three fifths or more of the greater curvature by resecting beyond the first short gastric vessel leading toward the spleen removal of all the antrum and all the pyloric ring and use of a short afferent loop of jejunum, no longer than is necessary to assure lack of tension on the anastomotic suture line It is not necessary to remove the ulcer itself it was left behind in 66 cases There is no evidence that an ultrapyloric exclusion procedure predisposes to a marginal ulcer Removal of an ulcer well down in the duodenum is fraught with danger to the common duct It makes no difference in the final result whether the anastomosis is ante or retrocolic or whether it is iso- or antiperistaltic

In practically all cases anastomosis of stomach and jejunum was done by Hofmeister's method with partial closure of the angle along the lesser curvature Open anastomosis is performed, using two layers of sutures, the inner of fine catgut for hemostasis and the outer of Halsted mattress sutures of silk or cotton through the seromuscular layers. Enterostomy clamps are not used because they obscure

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(5) New England J Med. 245 476-481 Sept. 1 1951

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bleeding points that should be individually ligated and may contribute to development of postoperative edema around the stoma.

The major complications and mortality depend on how the duodenum is handled and what happens to the duodenal stump after operation. If the ulcer is not too large or active and is near the pylorus or well down in the duodenum, after rather straightforward dissection clamps can be placed across normal tissue distal to the pylorus and clear of the indurated tissues around the ulcer Normal duodenum covered with serosa both anteriorly and posteriorly is found, and the stump can be closed with a single over-and-over suture of fine catgut and then infolded with a seromuscular row of Halsted mattress sutures of fine silk or cotton. If there is not enough normal tissue, a single row of well *placed nonabsorbable mattress sutures that bring the seromuscular* layers together without tension is safer than multiple rows that are too tight

If the duodenum is obscured and distorted by inflamma*tory reaction around a penetrating ulcer two stage resection* is best. The stomach is divided through the antrum well proximal to the pylorus, the ulcer mass is left behind and the antrum is closed in on itself while partial gastrectomy with gastrojejunal anastomosis is carried out. Six weeks later when there will have been resolution of the inflammatory process, the antrum and pylorus are removed The two stage procedure was used in 18 cases. Sometimes scar tissue causes foreshortening of the first and second portions of the duodenum and may involve the duodenal end of the hepatoduodenal ligament so much that the common duct is drawn over toward the area of the ulcer If scarring is dense the common duct is best protected by opening it higher and introducing a probe or a woven bougie through it into the duodenum. This allows dissection without damaging the common duct, and the duodenum can be closed without impinging on the ampulla When the common duct is opened, as was done in five cases, a T tube is left in for drainage

If there is any doubt concerning the security of the stump closure, it is good practice to thread the Levin tube through the gastrojejunal anastomosis into the afferent loop and to

place a large drain near but not touching the duodenal stump

When the duodenum cannot be closed the Welch maneuver is the best procedure This consists of passing a catheter through the open end of the duodenum and preparing a catheter jejunostomy in the efferent jejunal loop, thus setting up a controlled duodenal fistula After the gastrojejunal anastomosis is functioning well, the duodenostomy catheter can be withdrawn and the fistula will soon close

Of the survivors, 67 per cent were followed for 4-54 months. Three recurrent ulcers were found, two of which healed after vagotomy One patient has so few symptoms that he refuses surgery Causes for the three deaths were, respectively leakage at the site of a biopsy done to rule out cancer free leakage from the duodenal stump, and severance of the pancreatic duct and partial occlusion of the common bile duct by a suture

Special Clamps for Simplifying Gastrectomy Technic, useful particularly in the Polya Finsterer Hoffmeister modifications of the Billroth II operation and in the Billroth I operation, have been devised by D L. Stevenson[6] (Essex) The clamps (Fig 136) have a single longitudinal ridge on the lower blade, a reciprocal groove on the upper blade a single sharp terminal tooth on the lower blade and a reciprocal horn on the upper blade Though light in construction they give a secure grip with a minimum of crushing Routinely there are used (1) two such clamps with a small disk surmounting the hornlike process on the tip of the upper blade and (2) one such clamp with an additional rail attached to the upper blade, parallel to it and almost as long as it but without a terminal horn. The straight pattern of the rail clamp is usually used but the curved form gives additional assistance in circumventing an exceedingly high gastric ulcer The function of the rail is to (1) conjoin the tip of either one of the other clamps to any point along the length of its upper blade and (2) facilitate suturing of the new lesser curvature and closing of the duodenal stump

TECHNIC—After mobilization of the distal part of the stomach and adjacent duodenum, one of the identical clamps is applied immediately below the pylorus, the sharp terminal tooth being placed

(6) Lancet 1 1300-1302 June 16 1951

just on the margin of the duodenum (Fig 137) The duodenum is divided between this clamp and any crushing clamp which closes the pyloric end of the stomach. Beyond the special clamp, ¼ in. cut edge is left projecting, to be later shaved off flush with the clamp just before it is removed. The second identical clamp is placed across the stomach at the selected place on the greater curvature. taking a bite corresponding to the desired size of the gastrojejunal stoma or equal to the width of the clamped duodenal stump according to the form of resection intended. To prevent soiling, a Parker Kerr clamp is placed below, and the section of stomach between them is divided (Fig 137) The rail clamp is now conjoined with

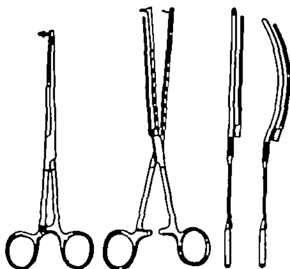


Fig 136 —Special clamps. (Courtesy of Stevenson D L: Lancet 1 1300 1302 June 16 1951)

the clamp on the greater curvature by engaging the rail on the latter's terminal hornlike process and sliding the clamp forward with blades open until the terminal tooth can be placed just on the margin of the lesser curvature at the proposed line of section (Fig. 138) Another Parker Kerr clamp is applied so that the remaining section of the stomach can be divided between it and the rail clamp, leaving a ¼ in. cuff projecting beyond the conjoined clamps to be shaved off just before removal

Handling and sewing of the gastric stump is facilitated by the support of the rail clamp, while the terminal teeth of the conjoined clamps prevent slipping A row of interrupted mattress sutures of no 2 silk is placed close together just below the rail clamp starting at the lesser curvature, the rail permitting insertion of the sutures quickly between the rail and the closed blades of the clamp The suture at the tip of the greater curvature clamp is left long after tying so as to tie it to the appropriate mucosal suture line of the gastrojejunal or gastroduodenal anastomosis. After

shaving off the cuff and removing the clamp, seromuscular suture is inserted Subsequent gastroduodenal or gastrojejunal anastomosis is made between the special clamps by which the stumps are controlled during insertion of the posterior seromuscular suture By circumcising the gastric stump just below the clamp, the vessels in the edge can be identified and ligatured, thus producing bloodless anastomo-

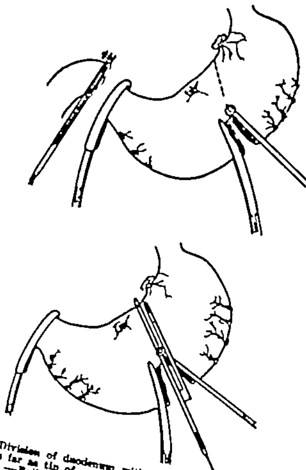


Fig 137 (top) —Division of duodenum with special clamp on distal portion division of stomach as far as tip of second special clamp.
Fig. 138 (bottom) —Rail clamp conjoined with special clamp so that term tooth can be placed on margin of lesser curve at proposed line of section.
(Courtesy of Stevenson, D L. Lancet 1:1300-1302 June 16 1951)

sis. Closure of the duodenal stump is accomplished by the san technic as that described for closure of the lesser curvature excep that the seromuscular sutures applied to the corners are of th three point purse-string type.

The conjoining clamps, and the technic described consid erably simplify the preparation of a measured gastric stoma and new lesser curvature facilitating anastomosis and im proving function.

Malfunctioning Stoma Following Subtotal Gastrectomy, Corrected by Converting Gastrojejunostomy to Gastroduodenostomy Ira Teicher, Murray N Friedman and Sidney Lipton[7] (V.A. Hosp, Brooklyn) report a case Malfunctioning stoma, caused by mechanical obstruction due to technical errors, adhesions due to infection around the anastomosis or stomal edema which is attributed to hypoproteinemia, is now rare There is still, however, the occasional case with an obscure etiology It may be due to the abnormal digestive physiology which results from exclusion of the duodenum by gastrojejunostomy

Man, 52, had a peptic ulcer for 10 years. On Feb. 11, 1949, an ulcer located at the pyloroduodenal junction was excised and antecolic, antiperistaltic, Polya type, subtotal gastrectomy done. A few weeks later there were epigastric pain and vomiting, with subsequent loss of 35 lb He did not respond to medical therapy Although a psychiatrist indicated that there was psychoneurosis with hysterical conversion symptoms, operation was done on Aug 1, 1949 No organic obstruction or stomal ulcer was found. The anastomosis, including 5 cm. stomach, was resected and antecolic, isoperistaltic Polya type gastrojejunostomy done. Two weeks later, abdominal pain recurred in the left upper quadrant. Intermittent vomiting also recurred. In October, x ray studies showed 50% gastric retention in three hours.

By May 15, 1950, he weighed only 85 lb. Operation was again performed. No anatomic abnormality to account for obstruction was found except slight kinking of the efferent loop The duodenal stump was mobilized, the gastrojejunal anastomosis resected, a Schoemaker modification of a Billroth I type of gastroduodenostomy done and a jejunostomy feeding tube inserted. Since he tolerated an oral diet well, the jejunostomy tube was removed on the 14th day There was no vomiting Although some discomfort persisted in the left upper quadrant, appetite improved. By July 19, 1950, he weighed 104 lb., and subsequently 125 lb Examination 8½ months after operation showed that intermittent discomfort had persisted in the left upper quadrant but weight was being maintained and there was no vomiting

Unfortunately, the diagnosis of psychoneurosis was not given an adequate therapeutic test Atony on a neurogenic basis was excluded because it is a prompt postoperative manifestation and responds to conservative treatment.

A satisfactory result was finally obtained by converting a Billroth II type of gastrectomy to a Billroth I. This left the patient with an upper gastrointestinal tract that more

(7) Ann. Surg. 134 1058 1062 December 1951

closely simulates normal since the duodenum is no longer excluded from its physiologic role in digestion (with consequent alterations in pancreatic and liver function) The gastroduodenal anastomosis is, moreover, of the end to-end type with intact circular muscle fibers around the stoma This effects more normal, slower gastric emptying, in contrast with the usual projectile (dumping syndrome) passage of food through a gastrojejunal stoma These comments are not meant to detract from the excellent results obtained with the Billroth II type of subtotal gastrectomy However, when the duodenum can be properly mobilized, a more physiologic condition results without the problems of stomal ulcer and disturbed physiology

[See the abstract of the article by Golden (p. 414) Perhaps that explains the difficulty experienced by the patient reported here. By using a Billroth I operation any obstruction of efferent loop of jejunum was avoided. —Ed.]

Study of Significance of Reactive Hypoglycemia Following Gastrectomy After partial gastrectomy for peptic ulcer there is an initial postprandial hyperglycemia, due to rapid absorption of carbohydrate from the small intestine as a result of speedy emptying of the stomach. Hyperglycemia may be followed by hypoglycemia, the pathogenesis of which is not established. T J Butler[8] (Bristol, England) found the incidence of postoperative hypoglycemic reactions under ordinary living conditions to be 5.2% in 600 gastrectomy patients Of 231 studied both pre and post-operatively 7 had hypoglycemia before operation After gastrectomy 12 had hypoglycemia, including 6 of the 7 who had it preoperatively These six patients noted that symptoms occurred about one half hour earlier than they did before operation. Of the 34 with hypoglycemia post operatively there were 9 with a history suggestive of pre operative hypoglycemia but these were not studied pre operatively Thus about half the patients with hypoglycemia symptoms after gastrectomy show some evidence of similar attacks before operation.

Increased insulin sensitivity after gastrectomy was well marked at the end of the first postoperative month. An important factor in determining time of onset of the delayed syndrome is the change over from two hourly feeding to

(8) Gastroenterology 19 99 112 September 1951

normal meal spacing The earlier the change takes place, the sooner hypoglycemic attacks become manifest

After gastrectomy there are two well defined responses to epinephrine administered during a glucose tolerance test. In patients without symptoms epinephrine effectively alters the second part of the curve by preventing the rapid fall of blood sugar In those with symptoms, it has no effect, and this is interpreted as indicating temporary inhibition of glycogenolysis.

The only effect observed during a glucose tolerance test after vagotomy is high initial hyperglycemia The addition of vagotomy to gastroenterostomy or gastrectomy augments the initial hyperglycemia and increases the risk of occurrence of hypoglycemia symptoms

Evidence obtained from this study suggests that the cause of the syndrome is a temporary inhibition of glycogenolysis in the liver in response to high degrees of portal hyperglycemia due to rapid absorption of carbohydrate The temporary inhibition as indicated by the negative epinephrine response, and the rapid removal of glucose from the blood by the tissues, as demonstrated by increased insulin sensitivity after gastrectomy tend to produce precipitous falls in blood sugar sufficient to cause hypoglycemic symptoms.

[Evidently the hypoglycemia is not associated with serious symptoms. Otherwise it would have been observed before.—Ed.]

Functional Obstruction of Efferent Loop of Jejunum Following Partial Gastrectomy Ross Golden[9] (Columbia Univ) states that functional obstruction of the efferent loop of jejunum resulting from spasm sometimes follows partial gastrectomy Such symptoms as epigastric fulness nausea and vomiting appear in most patients in the second postoperative week They disappear spontaneously in a few days in most and in two to three weeks in a few

X ray examination after partial gastrectomy when done in the morning after overnight fasting normally shows no residual fluid in the stomach a barium swallow passes immediately into the efferent loop of jejunum. This is true when the efferent loop leads away from the greater curvature side of the stomach pouch, as in Hoffmeister's anas-

(9) J A. M. A. 148 721 724 Ma 1 1952

tomosis If Polya's anastomosis has been done with the efferent loop leading from the lesser curvature side, the stomach empties much more slowly

In the syndrome of functional obstruction the stomach pouch usually contains a large amount of nonopaque fluid after overnight fasting The fluid consists of gastric secretions, bile and pancreatic juice which enter freely by afferent loop but cannot be expelled caudad Barium swallow is held up at the junction of the stoma loop and the efferent loop or in the efferent loop 2-3 in beyond the anastomosis. Sometimes a little barium passes through and the lumen of the efferent loop appears narrow (one fourth or less of normal caliber) The narrowing extends for several centimeters beyond which the lumen widens to normal Examination after the patient's full recovery discloses prompt emptying with the efferent loop of normal width.

Four symptomless patients were examined 7 10 days after partial gastrectomy, all had moderate narrowing of the efferent loop of jejunum extending to 6-7 cm below the anastomosis This indicates that temporary probably intermittent, delay in emptying the stomach pouch may not produce symptoms.

Spasm of the efferent loop is apparently due to localized temporary disturbance in muscle function resulting from necessary surgical trauma to the jejunum in anastomosis The syndrome appears less commonly after procedures requiring shorter than in those requiring longer, incision in the jejunal wall

Whatever the mechanism, obstructive spasm of the efferent loop is apparently a self limited physiologic disorder if blood protein and electrolytes are maintained at normal levels and distention of stomach pouch is relieved by suction evacuation.

Afferent Loop Studies after Subtotal Gastric Resection Stanley H Lorber and Harry Shay[1] (Temple Univ) describe a special intubation technic for adequate visualization of the afferent loop and more complete delineation of the stomal area after subtotal gastric resection The method is simple and is recommended when disease of the stoma or afferent loop is suspected but unconfirmed by routine

(1) Am. J M Sc. 222 644 653 November 1951

methods Routine x ray methods adequately show abnor mality in the gastric pouch remnant, but rarely is the afferent loop completely filled with barium.

Immediately after surgery, leakage from the anastomotic site or duodenal stump, although infrequent, is a serious hazard Malfunction of the stoma may be an early or late complication. Recurrent ulcer and duodenitis may follow surgery

TECHNIC.—A double-lumen Miller Abbott tube with a 5 cm bal loon tied over a bucket which fits into the smaller lumen is intro duced into the stomach under fluoroscopic observation The tube is

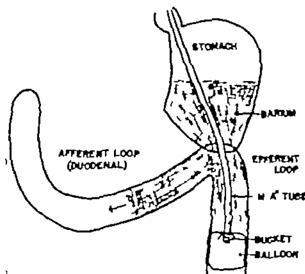


Fig. 139.—Intubation technic. (Courtesy of Lorber S. H., and Shay H.: Am. J M. Sc. 222:644-653 November 1951)

passed 3-6 in. into the efferent segment of jejunum and the balloon inflated with 50-100 cc. air to block the efferent loop While erect the patient is given 30 cc. barium water mixture. If the tube shows in the efferent segment and if obturation of the jejunum by the balloon is complete, the patient is given 240 cc. barium meal. The afferent loop usually fills up and by proper positioning of the pa tient the duodenal segment becomes visible. In some patients the initial amount of barium passes through the efferent segment and reveals the tube in the afferent loop in which case the balloon is deflated and barium instilled by syringe through the other lumen of the tube directly into the afferent loop (Fig 139)

This technic was used in four patients with troublesome digestive symptoms after subtotal gastric resection. One had ulcer in the stump and duodenitis High postoperative

gastric acidity probably permitted peptic activity to continue in the duodenum Another patient had an inflamed and engorged duodenal stump with ulcer like symptoms Another patient had a small perforation of the duodenal stump with a small pocket The last had a marginal ulcer

Demonstration of leakage from the duodenal stump by intubation may be an extremely valuable diagnostic aid if surgery for peritonitis is considered in the gastrectomized patient Intubation is not advisable during the first few days after surgery because of possible trauma to the stoma

Because of the variety of pathologic conditions possible in the stump area it is clear that duodenal ulcer should be removed with the resected stomach

Vagotomy Versus Gastric Resection Comparative Evaluation of Relative Effectiveness in Controlled Series of Cases These are the two most commonly utilized forms of surgical therapy for peptic ulcer Martin J Healy Jr., Sidney J Hellman and Paul K. Sauer[2] (New York City) selected comparable patients from 263 consecutive ones who underwent gastrectomy and 54 consecutive ones who underwent vagotomy during the same period To obtain more accurate comparison with vagotomy patients with duodenal ulcer and obstruction were excluded as were those on whom gastric resection was performed for other conditions A final selection of 95 patients treated with gastric resection and 41 patients treated with vagotomy was made The table shows the results of treatment which are preponderantly in favor of gastrectomy as determined by presence or absence of ulcer symptoms, secondary effects of the operations and the patient's estimates of his condition as compared with preoperative status If the results of subtotal gastrectomy for obstructed duodenal ulcer (71 cases) are included, percentage of patients improved increases from 87 to 90.8%

On the basis of personal interviews, rather than questionnaires, 10.2% of the patients who underwent gastric resection were found to have the dumping syndrome. In the vagotomy group persistence of active ulceration was found as often as healing Recurrence of bleeding was also much higher in the vagotomy group Activity of ulceration was less after gastric resection, partly because the ulcer was

(2) J A M A 147 368-373 Sept. 29 1951.

removed in most cases and roentgenographic demonstration was not available. Marginal gastrojejunal ulcer however, was demonstrated in 5 6% of the gastrectomy group Severe atony of the stomach was another undesirable complication of vagotomy In some patients this extended into the late postoperative period and required further surgery Mortality rates for the two procedures were comparable, 3.2 and 2.4% Early postoperative complications were of the

END RESULTS IN CONTROLLED SERIES OF PATIENTS WITH DUODENAL ULCER

RESULT	GASTRECTOMY		VAGOTOMY	
	No.	%	No.	%
Excellent	38	41.3	6	14.6
Good	33	35.9	10	24 4
Fair	9	9.8	11	26.8
Total improved	80	87.0	27	65.8
Failures	9	9.8	13	31.7
Postoperative deaths	3	3.3	1	2.4
Total failures	12	13.1	14	34.1

Percentages are based on definitive cases in which the end result could be established.

same order of frequency, but those after gastric resection were considered more serious.

The number of patients on whom gastrectomy or vagotomy was performed for marginal ulcer was too small to draw precise conclusions, but vagotomy had no apparent advantage

It was concluded that gastric resection can be expected to produce significantly superior results in the elective surgical therapy of intractable duodenal ulcer

[See the following report by Grimson *et al.*, who combined vagotomy with gastroenterostomy —Ed.]

Results of Vagotomy during Seven Years Clinical Observations and Tests of Gastric Sections in 175 patients are reported by K. S Grimson C R. Rowe, Jr., and H M Taylor[3] (Duke Univ) Of patients treated by vagotomy alone 28 of 50 with duodenal ulcer and 4 of 5 with gastric ulcer had satisfactory clinical results 18 required secondary gastroenterostomy and 3 gastric resection Vagotomy without drainage was therefore abandoned in 1947 Results of vagotomy and gastroenterostomy are encouraging Short loop posterior gastroenterostomy gave best results as against

(3) Ann. Surg. 135:621-636 May 1952.

pyloroplasty or exclusion operation Only seven patients complained of diarrhea Some describe such symptoms as fulness after eating bowel cramps and excessive gas none were major causes of discomfort One of every eight patients had temporary malfunction of the gastroenterostomy stoma This required longer hospitalization and secondary operation in one to release adhesions Late results of treatment were 91 4% satisfactory, 51 4% had moderately satisfactory and 3 43% had unquestionably unsatisfactory results No essential differences were found in results between private and ward patients. Continued excessive gastric secretion evidently a result of incomplete denervation was noted in a few patients Comparative insulin tests in 26 patients studied at three to seven years and in 12 unoperated duodenal ulcer patients revealed moderately high values for free acid (50-67 cc N/10 HCl) are sometimes obtained after operation but responses reached normal (75 132 cc N/10 HCl) in only one patient

Vagotomy can apparently be combined with gastroenterostomy with a mortality lower than for subtotal gastric resection and with fewer serious postsurgical complications. Benefits of vagotomy usually persist.

Vagotomy in Treatment of Gastrojejunal Ulceration Postoperative Clinical and Laboratory Study Waltman Walters, James T Priestley and Hiram H. Belding III[4] (Mayo Clin and Found.) studied 118 cases of gastrojejunal ulcer and 4 of gastroduodenal ulcer in which vagotomy was done with or without other procedures. The transthoracic route was used in 54, the transabdominal in 68 Of 97 with follow up data available gastrojejunal ulcerations followed gastroenterostomy in 41 and gastric resection in 53 gastroduodenal ulcer followed Billroth I resection in three.

Symptoms of gastrojejunal ulcer severe enough to warrant further surgery followed gastroenterostomy in an average of 9 8 years and gastric resection in an average of 3.3 Only 9.2% of 54 patients with moderate or massive hemorrhage before vagotomy and followed one to five years thereafter had further hemorrhage Preoperative x ray diagnosis of gastrojejunal ulcer was correct in 67.2% of those in whom the transabdominal approach was used

(4) J A. M. A. 148 603-608 Mar 8 1952

Gastric acidity was reduced below preoperative levels one to five years after vagotomy in 85.3% of cases with vagotomy alone for gastrojejunal ulcer after gastroenterostomy and in all cases of vagotomy for gastrojejunal ulcerations after gastric resection Vagotomy alone reduced gastric motility immediately in 54.6% of gastrojejunal ulcers after gastroenterostomy and 42.1% of gastrojejunal ulcers after gastric resection One to five years after vagotomy alone, however, motility was reduced or absent in only 16 7% of the cases of gastrojejunal ulcer after gastroenterostomy and in 8 3% of those of gastrojejunal ulcer after gastric resection

Over all correlation of insulin test with clinical results was excellent in 75% However in cases of proved ulcer recurrence, correlation of insulin test with clinical results was extremely poor

Vagotomy alone has produced excellent results in one to five years in 61.7% of 34 cases of gastrojejunal ulcer after gastroenterostomy and in 66 7% of 48 cases of gastrojejunal ulcer after gastric resection. Of patients with vagotomy alone for gastrojejunal ulcerations 88.2% with previous gastroenterostomy and 87.5% with previous gastric resection were free from ulcer symptoms.

One to five year results were excellent in five cases of gastrojejunocolic fistula treated by vagotomy with or without closure of openings in the colon. There is little evidence in the series that results after transthoracic vagotomy differ from those after transabdominal vagotomy

Effect of Combined Sympathectomy and Vagectomy on Gastrointestinal Tract. After combined sympathetic and parasympathetic denervation of the stomach, small bowel and proximal colon on six patients, John R Bingham Franz J Ingelfinger and Reginald H Smithwick[5] (Boston) carried out clinical studies on five of the group x ray studies on all six and jejunal balloon studies on one Vagectomy was performed on each patient for duodenal ulcer Sympathectomy was carried out on five for essential hypertension and on one for intractable pain

Patients 1-4 had simultaneous bilateral sympathectomy

(5) J A. M. A. 146 1406-1409 Aug 11 1951.

from the 2d to the 12th thoracic segment and vagectomy, whereas patients 5 and 6 had bilateral sympathectomy one and three years before vagectomy Absence of gastric secretory response to intravenously administered insulin, believed to indicate complete vagectomy, was observed in all six patients Absence of distention pain was taken to indicate complete sympathectomy

Perception of hunger, nausea and "bloating" sensations appeared unaffected by combined sympathectomy and vagectomy Appetite was unchanged in three patients and increased in two Heartburn disappeared postoperatively in one of two patients with this symptom despite the fact that the esophageal innervation remains intact. Bowel habits of three patients were unchanged, two with normal movements preoperatively had occasional bouts of diarrhea six months after vagectomy, and one who had passed mucus continued to do so postoperatively The gastrocolic reflex, when present preoperatively, appeared unchanged after operation thus suggesting that this reflex may function even when the alimentary tract is extrinsically denervated between the gastric cardia and the sigmoid.

The predominant x ray change exhibited by patients 1-4 was gastric hypomotility, five hour gastric retentions being 15 30 80 and 80% One of the patients with 80% retention had only 10% retention when examined one year later Despite x ray evidence of gastric retention, clinical signs of gastric stasis were absent, in contrast to the situation after vagectomy alone The rate of small intestine transit, estimated with due allowance for gastric retardation, appeared decreased in three patients and unaltered in the fourth. Patients 5 and 6 showed no initial delay in gastric emptying or hypomotility although a 25% five hour gastric retention was apparent. Since roentgen studies show that sympathectomy has no apparent effect on gastric motility the pronounced changes in patients 1-4 may be considered the results of vagal interruption, particularly as these changes correspond to the postvagectomy effects described by others.

Although it is tempting to infer that gastric hypomotility after vagectomy reflects absent parasympathetic stimula

tion rather than unbalanced sympathetic inhibition, hypomotility might be accounted for by temporary discharge of inhibiting impulses from decentralized sympathetic ganglions This latter explanation seems the more likely in view of the relative absence of a "vagectomy effect" in patients 5 and 6 in whom sympathectomy preceded vagectomy by one year or longer

Jejunal motility was tested in patient 6 at three different times Seven months after partial sympathectomy (bilateral splanchnicectomy and ganglionectomy from the 9th to 12th right thoracic segments and from the 4th to 11th left thoracic segments), jejunal motility appeared normal. In keeping with the presence of a potential pathway to the jejunum through the 12th left thoracic segment, the jejunum, but not the stomach or duodenum, was sensitive to distention pain. Fourteen days after vagectomy jejunal motility was decreased. Finally, three years after vagectomy and one year after complete sympathetic denervation of the small bowel, motility was increased beyond that of the first observation. These alterations were not regarded as significant

Gastroscopic Biopsy in Differential Diagnosis of Gastritis and Carcinoma Edward B Benedict[6] considers biopsy specimens of the stomach obtained through the flexible operating gastroscope to be of great value in differential diagnosis of malignant tumor and gastritis. Since the introduction of this gastroscope in 1948, 203 biopsy specimens have been obtained at Massachusetts General Hospital without any accidents or complications. Biopsy specimens can be secured under direct vision, gastric secretions can be aspirated and inflation and deflation of the stomach can be done at will. The last feature is important in diagnosis of malignancy because rigidity is suggestive of a neoplastic process.

Ten illustrative cases are reported In five in which clinical and x ray diagnosis was doubtful gastroscopic biopsy showed carcinoma. In two of these cases the patients had pernicious anemia but x ray findings were inconclusive One case was unique in that the patient was apparently psychoneurotic In another case x ray diagnosis was difficult because of excision of a benign gastric ulcer with

(6) New England J Med. 245 203-206 Aug 9 1951

pylorectomy and gastroenterostomy 17 years previously. In the last case, although the clinician and radiologist suspected carcinoma, it could only be proved by biopsy.

In five other cases a diagnosis of diffuse gastric malignancy was excluded with reasonable certainty by biopsy. In one case x-ray examination and gastroscopy showed large gastric rugae, but biopsy revealed normal tissue. In another, recurrent gastric carcinoma was suspected but normal tissue was found. In three cases, biopsy revealed gastritis. Too much faith must not be placed in a biopsy showing a nonmalignant process, as the value of any endoscopic biopsy depends entirely on the endoscopist's ability to secure a proper tissue sample. However, if diffuse carcinoma or lymphoma is suspected, considerable reliance may be placed on a gastroscopic biopsy that does not show it.

[This is a very valuable procedure. At the Barnes Hospital it has been used extensively for several years. As the author indicates, however, like all endoscopic procedures with biopsy, a negative finding is of less value than a positive one of carcinoma.—Ed.]

Critical Evaluation of Subtotal Gastrectomy for Cure of Cancer of Stomach. Gordon McNeer, Henry VandenBerg, Jr., Frederick Y. Donn and Lemuel Bowden[7] (Memorial Hosp., New York City) studied 92 cases to determine whether local recurrence in the gastric remnant, gastric bed, duodenal stump and local lymph nodes was a common finding in survivors of subtotal gastrectomy who subsequently died of cancer. In 46 cases there was local recurrence of the carcinoma either in the wall of the stomach or at the site of the gastroenterostomy 2.75 months after subtotal gastrectomy. There were 14 instances of recurrence of cancer in the duodenum, including 5 associated with gastric recurrence. In 48 cases there was local metastasis in the perigastric lymph nodes and stomach bed, with associated recurrence in the gastric remnant or duodenum in 29 of these.

In most cases there was evidence of distant metastasis at autopsy. There were 74 patients with local recurrence or metastases; 14 died of disseminated cancer without local recurrence and 4 died of other causes with no evidence of cancer.

Adenocarcinoma was the commonest histologic diagnosis. Neither the size of the lesion nor its histologic type was

(7) Ann. Surg. 134: 2-7, July 1951.

any guarantee against local recurrence Ulcerating cancer was the commonest gross type, infiltrating cancer the next most common and polypoid cancer the least common. Lesions measuring 3-5 cm. in greatest diameter were the most frequently encountered In only 3 of 60 patients in whom it could be determined had more than 75% of the stomach been removed

Among the 88 patients who died of cancer, average survival from subtotal gastrectomy to death was 20 3 months. Average survival for the 74 patients with local recurrence was 20 6 months, and for the 14 with distant metastases 18 9 months indicating that when gastric cancer is not cured, presence or absence of local recurrence has little apparent effect on average survival time

For cure of cancer subtotal gastrectomy as generally practiced apparently denies the chance for cure to about half the survivors of operation because of development of local recurrence To lessen this failure, there should be (1) standardization of the procedure of radical subtotal gastrectomy, with removal of the regional perigastric lymph nodes and omentum, or (2) routine use of total gastrectomy for all operable gastric cancers by experienced surgeons. Use of total gastrectomy is most logical.

Prognosis of Gastric Carcinoma Effect of Extent of Resection. Walton D Thomas, John M. Waugh and Malcolm B Dockerty[3] (Mayo Clinic and Found) selected for study 147 cases of gastric cancer in which operation was done during 1920-40 The lesions were of grade 3 or 4 malignancy (Broders) single, in the distal third of the stomach and 3-5 cm. in greatest diameter

Gross specimens, which had been in fixative for seven years or more, were measured and divided according to extent of resection Comparison of results following narrow resection (less than 3 cm above and/or less than 2 cm. below the lesion) with those following wide resection (3 cm or more above and 2 cm. or more below the lesion) showed no difference in five year survival rates. However when only patients with lymph node involvement at operation were considered, wide resections gave 2.5 times as many five year cures as narrow

(3) A.M.A. Arch. Surg. 62 847-853 June, 1951.

These findings suggest that (1) careful wide dissection of the regions of lymph drainage and removal of every known area of lymphatic spread are of distinct value and of prognostic importance (2) wide gastric resection is not essential for the nonscirrhous type of small cancer, and (3) subtotal gastric resection with as radical dissection of lymph nodes as is done in total gastrectomy should prove adequate With subtotal gastrectomy it is possible to remove all lymph nodes that are removed with total gastrectomy except for one or two juxtacardiac nodes of limited pathologic importance and the usually unimportant nodes of the splenic hilus When the carcinoma involves the upper third of the stomach the spleen with its hilar nodes can easily be included in subtotal resection

It is not suggested that the arbitrary measurements of narrow and wide resection, used for the fixed tissues in this study be adopted for surgery In general, the line of section of the stomach and duodenum above and below a carcinoma should be the maximal permissible margin under the circumstances. Both proximal and distal edges of all excised specimens should be examined microscopically, and if malignant changes are found, more tissue should be removed

Total gastrectomy for all small cancers is not justifiable on the basis of these investigations. However, total gastrectomy is possibly justified for small scirrhous or invasive types of cancer Proper removal of lymph node bearing tissue in subtotal gastrectomy gives a better prognosis than an improperly performed total gastrectomy which removes less lymph node bearing tissue

[It is interesting to see the different conclusions in the two abstracts above. Final agreement on the indications for total gastrectomy in cancer will probably have to wait until there is a much larger experience.—Ed.]

Gastric Polyps. Harry Yarnis Richard H Marshak and A. I. Friedman[9] (Mount Sinai Hosp., New York City) discuss 73 polypoid adenomas diagnosed in vivo by gastroscopy and/or x ray and 30 adenomas found in 8 735 routine autopsies. In the 73 in vivo group were 40 males between 60 and 80 There were 17 women among the autopsy group Whereas symptoms of gastric adenoma are not characteris-

(9) J A. M. A. 148 1088-1094 Mar 29 1952.

tic, bleeding and abdominal pain are common. Achlorhydria was found in 50 of 55 patients, histamine anacidity in 25, and normal acidity in 5 Atrophic mucous membrane was found in 38 of 42 patients who had gastroscopy Pernicious anemia was found in 8% Of 73 adenomas found in vivo. 42 were found in more than 2 500 gastroscopies (1.6%) Ten had concomitant cholecystitis and/or cholelithiasis An unrelated malignant growth was found in seven patients, two in the stomach and five in other parts of the gastro intestinal tract.

Roentgenologically, adenomas are rounded, smooth, translucent filling defects that may widen and displace normal rugal folds. There is no interruption of gastric contour or folds Pedicles are generally short, but as the tumor grows the stalk elongates Occasionally the body of a tumor prolapses into the duodenum as a result of active peristalsis

On gastroscopy the adenoma is a discrete, sharply demarcated tumor covered by smooth intact mucosa the tumor is usually sessile but may be broad based or pedunculated Sometimes the surface is granular or even mildly pitted Occasionally ulceration or central umbilication is noted

Carcinomatous degeneration was found in 2 of the 30 autopsies. Malignant degeneration of adenoma was found in one in vivo patient. Another patient in whom adenoma of antrum was diagnosed gastroscopically and roentgenologically returned four years later with medullary carcinoma in the same area, but proof of malignant degeneration in this case is lacking

Of the 73 living patients, 37 were operated on, 13 with excision of the adenoma and 24 with subtotal gastrectomy Of 68 followed up 54 were well. Of 32 who did not have resection and were followed 1 10 years, no evidence of malignant degeneration has been observed. Of 13 known dead. 2 died of stomach carcinoma unrelated to adenoma and 1 died of carcinoma in an adenoma Of those who had surgery 26 were living and well of those who had no surgery 28 were living and well.

Primary Lymphosarcoma of Stomach. William T Snoddy[1] (St. Louis) studied 34 cases from the files of Barnes Hospital and reviewed the literature to determine the type of

(1) Gastroenterology 20:537 553 April, 1952

treatment which has produced five year survivals. Average age in the 34 cases was 55, and 26 of the patients were men Pain was the chief symptom It usually was of the ulcer type but was more severe and persistent than is generally experienced by ulcer patients Other symptoms included vomiting in 15 (accompanied by nausea in 6), hematemesis in 5 and weight loss in 10 Anorexia, dyspepsia and eructation were noted by most patients At the time of surgery the condition in most cases was considered either carcinoma of the stomach or a benign ulcer Clinical study, x ray examination and gastroscopy did not give sufficient evidence for a definite diagnosis of gastric lymphosarcoma Operation was performed on 31 patients with 11 deaths within a month, 3 in less than a year, 3 in one to five years and 1 seven years postoperatively Thirteen patients are still alive, 3 for over five years Two of the patients who survived over five years had reticulum cell and two had small cell sarcomas.

There were 46 five year (or longer) survivals in 440 cases from the literature Treatment consisted of surgery alone in 21 cases, irradiation only in 13 and irradiation and surgery in 12

The treatment of choice appears to be surgery alone unless the lymph nodes are involved, and then postoperative irradiation should be used There is no correlation between clinical findings and length of survival Whether the patient has primary lymphosarcoma of the stomach or generalized lymphosarcomatosis with involvement of the stomach is the one factor that seems to influence length of life Lymph node involvement reduces the chances of cure but does not preclude the possibility of a five year survival.

Total Gastrectomy Operative Morbidity and Mortality in Series of 33 Consecutive Cases in 1947-50 are evaluated by Gordon McNeer and Lemuel Bowden[2] (Memorial Cancer Center) All but one patient had cancer Though operative morbidity was difficult to assess objectively 12 patients had uneventful convalescences and all 31 of the operative survivors were ambulatory at discharge Median duration of postoperative hospitalization was 17 days All patients, except those with recurrence of cancer, regained their appe-

(2) New York J Med. 52:231 235 Jan. 15 1952

tites and gastrointestinal comfort and gained weight within six to eight months Operative mortality was 6.1% A sufficient interval had not yet elapsed to determine five year survivors

Careful preoperative preparation was regarded as important, median of preoperative hospitalization was seven days Anemia, hypoproteinemia, cardiac abnormalities, bronchitis and psychic state were corrected The intestinal tract was prepared by repeated gastric aspirations, when indicated or by mild catharsis, enemas and intestinal sulfonamides Ether anesthesia was generally used via an endotracheal tube The stomach was resected with 1 cm. cuffs of the abdominal esophagus and of the duodenum distal to the pylorus, using open division of the duodenum and open antecolic esophagojejunostomy with two rows of interrupted silk sutures in every case Transabdominal route was used in 15 patients, transthoracic in 8 and combined abdominal and thoracic approaches in 15 Jejunojejunostomy is now seldom used A median of 3 pt. whole blood was given during and immediately after surgery every patient received antibiotics. Co-operation of a surgically minded internist in postoperative management is invaluable Complications were mainly pulmonary (18) due to faults in operative technic (8) cardiac (4) and intestinal (4)

Experimental Study of Protein and Fat Assimilation after Total Gastrectomy Tilden C Everson[3] (Univ of Illinois) reports on 39 individual seven day metabolism studies on 13 dogs subjected to total gastrectomy Constant daily diets were given containing 4 Gm. fat and 5 Gm protein/kg body weight. Both fat and protein assimilation were impaired after operation. An average of 41 5% of the ingested nitrogen was excreted in the feces, as compared with 12 8% in normal animals An average of 27 6% of the ingested fat was excreted in the feces of the experimental animals as compared with 2.9% in normal animals

Factors which may be responsible for the impaired fat and protein assimilation after total gastrectomy include loss of digestive function of the stomach. It is not probable that absence of either the digestive action of pepsin or the weak digestive action of gastric lipase could be responsible for

(3) Surgery 31 511-516 April, 1952

the nutritional disturbances noted Loss of the triturating function of the stomach seems an unlikely possibility Both vagotomy and loss of the secretagogic effect of hydrochloric acid are minor factors. Improper or inadequate mixing of food with pancreatic and biliary secretion is a possibility The ingested food may be well down the intestinal tract before the increased amounts of pancreatic and biliary secretion are delivered into the upper intestine There is more rapid passage of food down the intestinal tract after total gastrectomy and therefore less time for intestinal digestion and absorption Loss of reservoir function of the stomach may be a factor of major importance since the stomach usually releases food into the intestine intermittently and in small amounts.

Sequelae of Radical Gastric Resections were studied by R H. F Brain and F A R Stammers[4] (Birmingham) in 35 cases in most of which operation was done for carcinoma. Total amount of food taken in 24 hours was almost invariably less than before operation. The dumping syndrome was mild in 20 cases and consisted of postcibal fulness, not severe but definitely limiting the patient's capacity for food. It was severe in six cases, with evidence of autonomic stimulation such as sweating palpitation or faintness. Except in cases of frank vitamin B deficiencies dysphagia was rarely a distressing symptom. Diarrhea was invariably present in the early stages after operation but was not distressing later Constipation was unusual.

Steatorrhea was present in all cases. Doubling the fat intake and dividing the daily ration into small hourly feedings raised the percentage of fat absorbed The dumping syndrome is responsible for defective fat absorption because food is dumped en masse into the jejunum and the pancreas does not receive the neurogenic or hormonal warning until too late Studies show that the normal enzymes are present, neutral fat can be absorbed through the lymphatics bowel motility is normal and liver function is normal.

Iron deficiency was not present except in the immediate postoperative period. At this time it is related to the blood loss at surgery Macrocytosis was present in the peripheral blood in all cases Bone marrow biopsies showed a macro-

(4) Lancet 1:1137 1140 May 26 1951

normoblastic hypercellular marrow This blood picture accompanies other types of steatorrhea, e g., idiopathic steatorrhea, sprue and vitamin B deficiencies.

There were nine cases of vitamin B complex deficiency Diagnosis was based on presence of glossitis, pharyngitis, esophagitis, cheilosis, corneal hypervascularity and clinical response to vitamin B complex All patients with recognized deficiency were cured, but early in the series two patients died with gross pharyngitis and esophagitis so severe that nutrition was impossible Vitamin deficiency was most common in cases of sepsis, indicating that rapid multiplication and migraton of organisms in the upper alimentary tract increase the demand for vitamin B complex.

The main causes of wasting after radical gastrectomy are poor capacity for food associated with the dumping syndrome and malabsorption of fat. Treatment consists of a high fat diet (100-120 Gm. fat daily), with a correspondingly high caloric intake and multiple small meals so that fat is taken 8-10 times in 24 hours. The patient should not drink with meals and should avoid sugar protein hydrolysates and other substances capable of producing a high intrajejunal osmotic pressure withdrawing fluid from the bowel and causing further distention, and perhaps the dumping syndrome Vitamin B deficiencies can be prevented by routine administration of vitamins and eradication of sepsis

Experimental Evaluation of Effectiveness of Pancreatin in Reducing Fecal Nitrogen and Fat Loss Following Total Gastrectomy Tilden C Everson[5] (Univ of Illinois) found pancreatin in adequate doses to be effective in appreciably reducing fecal nitrogen loss after total gastrectomy During administration of 10 Gm. pancreatin daily to 12 dogs with total gastrectomy the fecal nitrogen level was 26 3% as compared with levels of 39 7% and 49.2% before and after administration The average fecal nitrogen excretion in normal dogs was 12 8% The effect of 30 Gm. pancreatin daily was about the same as 10 Gm. daily

Pancreatin slightly or moderately reduced fecal fat loss after total gastrectomy in 8 of the 12 dogs. Average fecal fat loss in normal dogs was 2.8% as compared with an average of 22.4% in dogs with total gastrectomy given 10

(5) Am. Surg 135 406-410 March, 1953

Gm pancreatin and 25.3% and 31.4% during the two control periods. Raising the dose to 30 Gm daily had a slight additional effect.

Pancreatin is considered useful after gastrectomy because the secretogogic effect of hydrochloric acid on the pancreas is lost and because inadequate mixing of food with pancreatic secretions may occur.

Construction of Food Pouch from Segment of Jejunum as Substitute for Stomach in Total Gastrectomy is described by Claude J Hunt[6] (Kansas City, Mo.)

TECHNIC.—After the stomach, great omentum and spleen are removed and the duodenal stump closed, the jejunum is divided be-

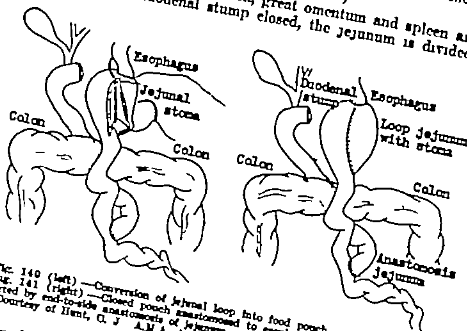


Fig. 140 (left).—Conversion of jejunal loop into food pouch.
Fig. 141 (right).—Closed pouch anastomosed to esophagus. Duodenal contents are diverted by end-to-side anastomosis of jejunum.
(Courtesy of Hunt, C. J.: A.M.A. Arch. Surg. 64:601-608, May 1952.)

tween clamps 12-14 in. below the ligament of Treitz. The distal limb of jejunum is brought up anterior to the colon and the end doubled on itself in a side-to-side manner for about 6 in. (Fig. 140). The sides of these loops are sutured together, and an anastomosis with a full length stoma is made, incorporating the transected end of jejunum (Fig. 141). This forms a large pouch which is anastomosed to the esophagus and further supported by sutures to the diaphragm and surrounding peritoneum to relieve tension. The proximal jejunum is then anastomosed to the side of the distal jejunum, well below the pouch.

This technic was used in seven patients without mortality or undue morbidity. A Levin tube passed into the jejunum

(6) A.M.A. Arch. Surg. 64:601-608, May 1952.

well below the Roux Y anastomosis for feeding was left in place an average of nine days In no case was there evidence of a leak at the site of anastomosis No patient complained of reflux esophagitis, and all took progressively more food with corresponding slight weight gains In one patient small bowel obstruction developed and was surgically relieved.

Although no patient is considered cured because of the extent of the lesions, the technic provides an adequate pouch for food intake, lessens requirements for frequent feedings, facilitates a balanced diet, diverts the duodenal contents and reduces incidence of reflux esophagitis. The esophagus is so vulnerable to bile and pancreatic juice that the Roux Y procedure should be used whenever the stomach is entirely removed Terminolateral anastomosis of esophagus to jejunum, even with a wide enteroenterostoma, does not divert all bile and pancreatic secretion as well as the procedure described by Orr or this technic of pouch formation and Roux Y diversion of duodenal contents.

BILIARY TRACT

Incidence of Gallstones and Their Correlation with Other Diseases In a review of autopsy data on 29,779 patients age 20 or over, Marshall M Lieber[7] (Jefferson Med. College) found gallstones in 11.6% Gallstones are rarely found in persons under 20 Incidence differed with age, sex and race. There was a progressive increase from one decade to the next. More white persons than Negroes and more women than men had gallstones The ratio of affected white women to white men was 2.2 1 and of Negro women to Negro men 2.7 1 The first high point in incidence in white women occurred between the ages of 50 and 60 and in Negro women between 60 and 70 In white men this occurred between 60 and 70 and in Negro men between 70 and 80 Gallstones continued to form through all the decades in white men and women and up to age 90 in Negro men and women.

Carcinoma of the gallbladder was associated with a 3-fold increase in incidence of gallstones in women, a 5-fold increase in white men and a 10-fold increase in Negro men.

(7) Am. Surg 135 394-405 March, 1952.

Gallstones were present in 30.2% of all diabetics over age 20 An appreciable increase in incidence occurred in each age group and in both sexes of each race, this increase was considerably greater in the Negro race In diabetics age 50 or older gallstones were present in about one of every two white women, one of every three Negro women, one of every five white men and one of every seven Negro men

Gallstones were found in three fourths of all white women and one third of all white men with acute pancreatitis None were found before age 40 Of 18 Negro women with acute pancreatitis with or without fat necrosis, 4 had gall stones, and of 21 Negro men with this disease only 1 had gallstones A moderate increase in incidence was evident in men and women of each race with portal cirrhosis

Both white and Negro women with peptic ulcers showed an increased incidence of gallstones Conversely the incidence in men decreased except for white men with duodenal ulcer who showed a slight increase

The incidence of gallstones decreased in men and women of both races with pernicious anemia and tuberculosis, except in Negro women age 50 or over with tuberculosis These showed a twofold increase

Present or Past Cholelithiasis Diagnosed at Laparotomy Study of 730 Cases of Carcinoma of Right Portion of Colon in patients aged 40 or older is reported by Charles W Mayo and Madison J Lee Jr[8] (Mayo Clinic) In 9 4% gallstones were palpated by the surgeon at operation although they had been unsuspected in half the cases. Even when diagnosed by x ray preoperatively gallstones usually were not the cause of symptoms In 7 4%, there was a history of operation for cholecystic disease, usually with gallstones, more than one year previously In 1.5%, gallstones were diagnosed by x ray but mention of their presence was not made by the surgeon. Thus, 18 3% of the patients had or probably had had cholelithiasis. Incidence according to sex was 27 6% for women and 11.8% for men. These incidences approximate those based on autopsy studies at Mayo Clinic in which 21.7% of 11 650 patients over 40 had or had had gallstones, with incidence of 32.2% for women and 16.2% for men.

(8) S. Clin. North America 31:1217 1223 August, 1951

In the 69 patients with gallstones palpated at laparotomy, the gallstones were left undisturbed in 53, 16 had cholecystectomy, 11 in conjunction with the colon operation and 5 before the colon operation. In 10 of 16, symptoms had been considered due to gallstones until carcinoma of the right part of the colon was discovered at operation.

Subsequent symptoms thought due to cholecystic disease were noted by 5 of the 53 patients whose gallstones were left undisturbed at laparotomy, 1 of whom returned with severe symptoms to have cholecystectomy Cholescytectomy was also performed subsequently on two patients who had no evidence of cholecystic disease at the time of the colon operation, one had subacute cholecystitis without stones and the other had a putty like material in the gallbladder and common duct.

The authors believe that patients in whom silent gall stones are discovered at laparotomy or by x ray should be told that gallstones are present which might lead to further trouble The mere presence of gallstones does not constitute an indication for cholecystectomy Elective surgery may be suggested according to the indications of the individual patient, and temporizing is often indicated in view of the presence of other lesions, such as carcinoma of the colon in this study Multiple small gallstones warrant operation more than do single stones and development of cholecystitis usually demands operation. When the patient's condition warrants and exposure is adequate cholecystectomy at the time of operation for another abdominal lesion should be considered if there is inflammation in the wall of the gall bladder or if multiple small stones are present.

Symptoms due to carcinoma of the right portion of the colon may simulate those of cholecystitis The presence of gallstones does not necessarily indicate that they are the cause of such symptoms Further exploration of the colon and other abdominal viscera should be performed at the time of intended cholecystectomy Conversely the gallbladder should be palpated for gallstones during laparotomy for any condition.

[Every abdominal operation should include an examination, at least by palpation, of the abdominal and pelvic viscera. Surprising results often occur —Ed.]

The Nonvisualized Gallbladder Francis Martin and Antonio G Massimiano[9] (St. Luke's Hosp, Pittsfield, Mass) state that nonfunctioning gallbladders that come to operation show a high incidence of stones and an even higher percentage of gross disease Review of 232 cholecystectomies showed that calculi were found in 87.5% of gallbladders, gross disease in 93% Diagnosis of calculi was made on cholecystograms in 145 cases (62 5%), at surgery 140 (96 5%) had calculi There were 73 nonvisualized gallbladders and 14 with negative or indefinite findings.

Of the nonvisualized gallbladders, 82% showed calculi at surgery In 11% there was definite disease such as acute edematous gallbladder, strawberry gallbladder or markedly thickened gallbladder that had previously been the site of cholecystostomy Seven per cent showed no significant disease.

Of the 14 cases with negative or indefinite results on diagnostic study, 3 gallbladders contained stones and 3 showed cholesterosis at surgery Four showed no disease In one reported "poor concentration" a deformity of the duodenum was found Two with "faint filling" revealed a hydrops and one in which a plain film of the gallbladder was negative showed "muddy bile"

Nonvisualization of the gallbladder in absence of disease may be due to (1) previous removal of the gallbladder, (2) failure of the patient to ingest the dye, (3) improper absorption of dye from the small bowel (due to pyloric obstruction, active duodenal ulcer and hyperchlorhydria, too rapid passage of dye in severe gastrointestinal upsets or by improper use of laxatives, small bowel disease or pancreatic obstruction) (4) failure of the dye to reach the gallbladder in severe liver disease or hepatic or cystic obstruction (5) physiologic stasis of the gallbladder in which thick and concentrated bile prevents entrance of fresh dye-laden bile or (6) a cholecystic anomaly

To ensure gallbladder visualization several procedures are recommended. Patients must be given careful instructions and follow up inquiry made Studies should not be done in an acutely ill patient. Patients on fat free diets should ingest

(9) New England J Med. 246 488-490 Mar 27 1952.

some fat six hours before taking the dye to ensure an empty gallbladder that can receive the dye Drugs such as morphine, epinephrine, pituitrin*, acetylcholine, eserine, histamine, banthine and nitrates, which would influence the physiology of the biliary tract, should be stopped.

Attention to details will also improve roentgenologic interpretations of nonvisualized gallbladders, so that diagnostic accuracy will approach the reported operative pathology

[The criteria for interpreting cholecystograms laid down 27 years ago still hold good.—Ed.]

Obstructive Jaundice with Negative Findings at Operation is discussed by M Bjorneboe, P Iversen and K. Traut-

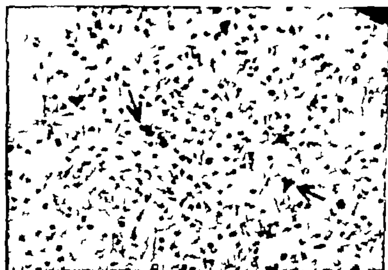


Fig 142.—Liver biopsy after four months of jaundice. Arrows indicate bile plugs Inflammatory changes are not evident. (Courtesy of Bjorneboe M., *et al.*: Acta med scandinav 141:249 255 1952.)

ner[1] (Copenhagen) *Cases reported in the literature include* the cholangiolitic type with inflammatory changes in periportal spaces seen on biopsy with inflammatory infiltration believed to cause bile stasis a type with biliary stasis but no inflammation on biopsy, obstructive jaundice caused by inspissated bile or mucus in bile ducts in children, and xanthomatous biliary cirrhosis beginning as obstructive jaundice of obscure origin.

Woman, 38, with articular pain and swelling particularly in fingers, hands and feet, was hospitalized for injection of sanocrysin

(1) Acta med. scandinav 141:249 255 1952.

Itching and jaundice followed the fourth injection Articular symptoms subsided on appearance of jaundice Four months after onset of jaundice, icteric index was 170-200 Liver was not enlarged, results of thymol and galactose tests were normal. Stools were gray Urobilinuria varied in intensity Liver biopsy showed obstructive jaundice (Fig 142) Surgery showed the gallbladder was collapsed and the common bile duct of normal appearance and patent to probing Cholangiography showed unimpeded passage to the duodenum and complete filling of intrahepatic ramifications. She died of clinical pulmonary embolism one week after surgery but autopsy did not explain death. Liver and bile ducts did not account for biliary stasis. The gallbladder contained a few milliliters of viscous bile. Tissue from right and left hepatic lobes also showed biliary stasis

The authors report four other cases of this type all apparently biliary stasis without inflammation, with one possible exception which may have been xanthomatous biliary cirrhosis. Numerous bile plugs found on biopsy distinctly show that the hepatic cells secrete bile Slender bile ducts found at operation make localization of obstruction to extrahepatic bile ducts improbable it must therefore be localized between the two parts. Possibly benign structure of intrahepatic ducts or chemical change of mucus in the bile ducts with adhesion to the wall had occurred Three patients lived and were well shortly after surgery, one died and one was not traced

Benign Extrahepatic Biliary Tract Obstruction Robert D O'Malley Arthur H Aufses, Jr and Allen O Whipple[2] studied 54 patients with benign extrahepatic biliary stenosis 46 had had a total of 71 previous biliary tract operations contributing to or followed by obstruction. To correct the condition, 73 operations were performed on the 54 patients 23 duct-to-duct anastomoses in 14 patients 39 duct-to-duodenum anastomoses in 34 patients 8 Roux Y procedures, and 3 implantations of the external biliary fistula into either the stomach or the jejunum

Of the 54 patients, 40 were rehabilitated In the duct-to-duct group there was a 43% operative success 10 (71%) of the 14 patients were rehabilitated There was a 61% operative success in the duct-to-duodenum group with 70% rehabilitation. In the Roux Y group operative success and rehabilitation rates were both 75% Fistular implantations were all unsuccessful. Results were considered good if there

(2) Ann. Surg 134:797-807 November 1951.

were no evidences of recurrent biliary obstruction, if the patient was free of jaundice, pruritis, chills and fever

Four types of prostheses were used the rubber T tube, rubber catheters, either "permanent" or temporarily inserted and brought out of the wound for later removal; rubber Y tubes, and vitallium tubes A prosthesis was used to splint the anastomoses in 59 of the 70 operations, excluding the fistula implantations The T tube was used 30 times in 25 patients with an operative success of 50% and a rehabilitation rate of 60% Rubber catheters were used in 15 procedures on 15 patients. The method was successful in three cases, one each of duct to-duct anastomosis, choledochoduodenostomy and Roux Y procedure Of five patients in whom a vitallium tube was used for duct to-duct anastomoses, three were rehabilitated. In seven choledochoduodenostomies in which the vitallium tube was used, five patients are well. One patient who had a Roux Y procedure, in whom the vitallium tube was used died in the hospital. Five patients are well after a duct to-duodenum procedure without the aid of a prosthesis Five of the six Roux Y operations without a prosthesis were successful

Two patients died after operation one of severe septicemia after two duct to-duct repairs and one of a massive gastrointestinal hemorrhage 10 days after a Roux Y procedure the sixth attempt at repair There were five duodenal fistulas postoperatively all closed without operation Four patients hemorrhaged after a Roux Y procedure

Success of the repair was inversely proportional to the number of previous operations on the biliary tract In the 40 rehabilitated patients, average of operations/patient was 1 4 Of the 14 failures there was an average of 2 4 operations/patient

Of the 12 living unrehabilitated patients six died 14 months to 2½ years postoperatively Five died of biliary cirrhosis and recurrent cholangitis and one of liver necrosis Of those living one had hepatic failure, two had been operated on again and three have recurrent attacks of cholangitis.

In performing any of these procedures, certain principles must be adhered to for permanent relief (1) complete excision of existing ring of scar tissue (2) mucosa to-mucosa

approximation in anastomosis (3) gentle handling of tissues, (4) completion of anastomosis without tension on the suture line It is not wise to bridge an existing defect with a rubber or plastic tube surrounded by omentum or peritoneum because of danger of contracture Attempts to unite an external biliary fistula to the gastrointestinal tract are unsuccessful because blood supply of the tract is impaired and stenosis follows.

Choledochal Compression in Chronic Pancreatitis Diagnosis and Treatment P Mallet Guy, L Eicholz[3] (Lyon) and R Almasque Deden (Buenos Aires) reviewed 36 cases among 1,575 biliary interventions performed under manometric and radiographic control Two had complete stenosis and were treated by choledochoduodenostomy Eighteen had relative stenosis characterized by unusually high manometric curves with cholangiographic pictures showing difficulty in evacuation and deformation of the pancreatic portion of common duct, with upper dilatation. Of these 12 showed signs of common duct obstruction and symptoms identical to those of common duct stones whereas 6 had only pain without signs In 16 cases virtual stenosis was demonstrated by similar x rays but manometric readings were normal of these 10 had vesicular and 6 common duct syndromes

No characteristic signs allow clinical diagnosis of this condition. Since cholelithiasis and pancreatitis are often associated it is difficult to decide which leads to common duct obstruction. Neither inspection nor palpation can confirm or rule out stenosis. Only manometric and radiographic study at operation allows accurate diagnosis of the various modalities. Biopsy may be misleading if only a portion of peripheral, inflamed tissue is taken. In pancreatic carcinoma, dilatation of the duct is greater its walls retain their suppleness and the stenosis is regular Tumors of the papilla of Vater may invade the distal segment of the duct cholangiography will show invasion of the duct and not the tortuosity produced by unequally hypertrophied glandular lobes

External biliary drainage gives frequent failures in this condition. Cholecystogastrostomy can be done only when

(3) Lyon chir 47:278 304 April, 1952

there is no cholecystic damage Otherwise, cholecystectomy is followed by choledochoduodenostomy or more often, particularly in case of relative or virtual stenosis, a cysticoduodenostomy The latter, which is simple and mild, was done in 16 cases with good results

Fibrotic Stenosis of Terminal Common Duct. Philip F Partington[4] (Western Reserve Univ) reports observations on three patients with pronounced symptoms of biliary tract disease who were found to have fibrotic stenosis of the terminal common duct For several years all had had sharp pain in the epigastrium and right upper quadrant which

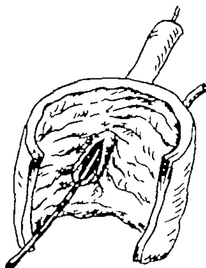


Fig 143 —Stenotic and thickened sphincter of Oddi sectioned over catheter. (Courtesy of Partington, P F Surgery 31:367-372 March 1952.)

radiated to the back. Pain could be produced by morphine in two Cholecystograms revealed gallbladders which filled, emptied with some delay and contained no stones. The common ducts were slightly dilated and terminated with abrupt narrowing in the region of the sphincter of Oddi

Exploration was done on all patients, and operative cholangiograms confirmed the preoperative diagnosis of partial stenosis of the terminal common duct. Two gallbladders appeared normal and one was thickened. One patient had T tube drainage for three months with no relief from symptoms. Transduodenal section of the sphincter of Oddi

(4) Surgery 31 367-372 March, 1952

was performed, but the gallbladder was not removed In two patients the sphincter of Oddi was cut through the superior border over a grooved director or catheter (Fig 143) the gallbladder was removed and a T tube was placed in the common duct Biopsies of the sphincter revealed increased fibrous connective tissue in the muscle and considerable thickening Both patients had duodenal scarring suggestive of inactive duodenal ulcers

All three patients obtained relief from the attacks of severe right upper quadrant pain. Only one is asymptomatic, however, and the follow up period has been short (longest period, 18 months) One patient has an incisional hernia and one epigastric distress relieved by food or amphojel*

Peptic ulcer may be an associated condition of possible etiologic significance in the formation of this type of fibrosis Other suggested causes are chronic cholangitis, spontaneous passage of stones or instrumental dilation of the sphincter and an area of localized pancreatitis

Congenital Atresia of Bile Ducts Associated with Erythroblastosis Fetalis All types of obstruction of the biliary tract are common in the newborn child with erythroblastosis fetalis John T McGeehan, James Baird Butchart and Dudley P Walker[5] classifies the causes in four categories (1) transitory obstructive phase due to inspissated bile plugs in the extrahepatic biliary passages (2) pigment stones causing obstruction of the extrahepatic ducts, (3) intrahepatic obstruction with cirrhosis of the liver and bile thrombi in the intercellular bile ducts and (4) congenital atresia of the bile ducts Actual atresia of the ducts with erythroblastosis fetalis is uncommon, but occurrence of the two conditions together and in different members of the same family have raised the question of an etiologic relation between them

Analysis of the five previously reported cases and one seen by the authors revealed no evidence to support the view that bile plugs cause fibrosis and organization in the intra and extrahepatic bile ducts. Furthermore, it seems unlikely since bile plugs could not have time to occur fibrose and organize in the short space of time of the last few days of intrauterine life The biliary tract is well de

(5) J Pediat. 39:578-584 November 1951

regurgitation into the main passages, transpapillary reflux and signs of infection when gallstones are seen in the gall bladder or patency of the duct is doubtful, surgery is indicated. At operation, cholangiography is superior to exploration with a finger or sound.

[The incidence of these fistulas (2 5%) of all patients who have biliary surgery is much higher than found in the United States.—Ed.]

Recurrent Cancer of Common Bile Duct and Periampullary Region. Review of reported cases by Robert J Booher and George T Pack[7] (Memorial Cancer Center New York City) showed that after transduodenal local excision 14% of the patients who survived operation were well for 3-22 years and 30% died of recurrences in 1-3 years Moreover, at Mayo Clinic in 76 9% of the cases in which local excision was done malignant cells were found at the periphery of the sectioned specimen. The radical Whipple operation is therefore considered advisable since it conforms to current cancer spread concepts The following case is one of a still resectable, locally recurring periampullary cancer

Man, 74, was hospitalized with jaundice and itching four years after local excision of an adenocarcinoma of the ampulla, grade II, originating in the wall of the common duct. Reimplantation of the common bile and pancreatic ducts had been done. Laparotomy revealed a hard mass in the head of the pancreas overlying the third portion of the duodenum with extension into the uncinate process. The thick walled common bile duct was dilated to 2 cm. Pancreaticoduodenal resection, an end to-end choledochojejunostomy and an oralis totalis, end to-side antiperistaltic gastrojejunostomy were done. A pancreatic fistula was established on the sixth postoperative day but healed in about two months. Weight was regained. Dysphagia, however, developed six months after operation. Further examination was refused. Diagnosis was adenocarcinoma of the head of the pancreas with invasion of the duodenum and partial obstruction of the ampulla of Vater, and lymph node metastases. Histologically the specimen was compatible with the adenocarcinoma of the common duct removed four years previously but was more malignant.

This case illustrates the observation of other workers, that cancer of the ampulla early penetrates surrounding structures to obscure its exact origin even though it metastasizes late Reoperations for cancer are never as favorable as primary attempts at cure The concept of local resection in periampullary cancer is no longer tenable, especially in view of Ewing's classification. The three types of bile duct

(7) A.M.A. Arch. Surg. 64 224 237 February 1952

lesions described by him are (1) villous growths which may fill and distend the duct but which promptly recur after local excision, (2) a nodular form with infiltration in the submucosa and muscular wall, and (3) a diffuse growth along the duct, which converts it into a rigid tube from which project minute carcinomatous vegetations.

Indications for Surgery in Gallbladder Disease Robert M. Zollinger and Edwin H. Ellison[8] (Univ Hosp., Columbus, O) believe that uniformly good results can be obtained with gallbladder surgery if the symptoms of the patients selected for operation arise from the gallbladder or its ducts and if operation is thorough and complete Best re

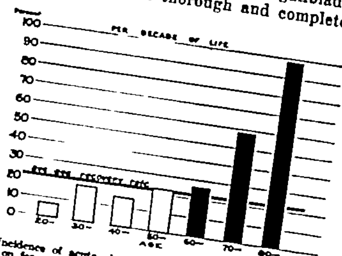


Fig 144—Incidence of acute cholecystitis/decade of life in 231 consecutive patients operated on for gallbladder disease. (Courtesy of Zollinger R. M., and Ellison, E. H. Illinois M. J 100 121 128 August, 1951)

sults follow surgery on patients with gallbladder colic and gallstones, as demonstrated by cholecystography A nonfilling gallbladder on one occasion should not be accepted as pathologic, but the dye test should be repeated with reinforced dye If the gallbladder is not visualized at the second examination, surgery may be recommended, provided the symptoms are sufficiently severe and a complete x ray survey of the gastrointestinal tract has been noncontributory Too much emphasis should not be placed on poor filling delayed emptying or an unusual size or shape of the gallbladder Heart disease must be considered as a cause of the patient's symptoms. It is not a contraindication

(8) Illinois M. J 100 121 128 August, 1951

to gallbladder surgery, and many cardiologists believe that removal of a diseased gallbladder is beneficial to a cardiac patient Diseases that may coexist with gallbladder disease include gastric neurosis, duodenal ulcer and pancreatitis.

A survey of 231 consecutive patients operated on for gall bladder disease over three years showed an increase in the two commonest complications, acute cholecystitis and com mon duct stone, in patients over age 60 (Figs. 144 and 145) Over all incidence of carcinoma in this series was 2 5%, but in patients over 60 it was 9% Gallstones were found in five of the seven patients operated on.

Of 238 patients operated on for gallbladder disease 30%

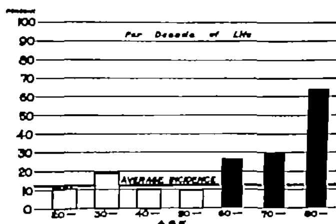


Fig 144 —Incidence of common duct stone/decade of life in 231 consecutive patients operated on for gallbladder disease. (Courtesy of Zollinger R. M., and Ellison, E. H.: Illinois M. J 100 121 128, August, 1951)

were over age 60, and 75% of these had complications. Incidence of common duct stone was 1 in 3 of acute cholecystitis, 1 in 4 of acute pancreatitis, 1 in 10 and of car cinoma of the gallbladder 1 in 11 Since patients with com plications usually give a history of multiple attacks, earlier operation would not only have reduced the operative risk but would have spared the patients much distress

Patients with acute cholecystitis require prompt hospi talization and individualized management The optimal time for operation depends on the severity of the disease and response to treatment. Signs of generalized peritonitis call for surgical intervention as soon as the patient s condition permits. An impending gangrene or perforation should be

suspected when the white cell count exceeds 20,000 Recurrence of pain sufficient to require narcotics, an increasing temperature or white cell count or a decreasing vital capacity calls for prompt surgery Operation is delayed and conservative measures are justified in patients showing continued regression of the disease Operation can be performed in five to seven days as a semielective procedure on an "improved risk" patient.

Common duct stone is a common complication. Such stones have been found in nearly three of every four patients with jaundice and in 50% of those who were not jaundiced. They have been recovered in 50% of all patients whose common duct was described as either moderately or considerably enlarged

Conservative management is necessary for acute pancreatitis When the patient has fully recovered, a complete investigation of the biliary tract should be done and the gallbladder removed as indicated The common bile duct is explored in all instances Gallstones were found in all patients who were operated on, and common duct stones were found in 23 5%

The finding of an occasional patient who complains of recurrent symptoms after cholecystectomy is indicative of one of the following (1) incorrect preoperative diagnosis, (2) incomplete surgery including failure to remove the gallbladder or cystic duct or to find a common duct stone, (3) complications resulting directly from operation, including injury to the duct system, and (4) residual nonoperable disease of the biliary tract, including "biliary dyskinesia."

[Most surgeons would undoubtedly agree with nearly all of the conclusions of the authors. They are to be commended for advising "individualized management" of patients with acute cholecystitis. However the finding of stones in the common duct in 50% of all patients without jaundice seems high.—Ed.]

Timing in Surgical Treatment of Acute Cholecystitis Paul T DeCamp Alton Ochsner Thomas G Baffes Huldah Bancroft and William Bendel[9] analyzed 468 consecutive cases of acute cholecystitis seen during 1940-51 at Charity Hospital of Louisiana) Three different policies of management were followed (1) operation as soon as the patient could be prepared, (2) delayed operation and (3) prompt opera

(9) Am. Surg. 135:734 750 May 1952

tion on patients seen within 72 hours of onset of the acute attack, but delayed operation on those admitted 4-10 days after onset Of the 468 patients, 61.7% were operated on promptly, 37% had a delayed operation and 1.3% died without surgery No significant difference in mortality rates was observed between the entire group with prompt operation and the entire group with delayed operations—7 6 and 7 4% In 125 cases the initial conservative therapy was successful, and operation was performed later as an elective procedure In 48 cases the disease progressed despite conservative therapy and operation had to be performed as an emergency procedure Of 83 patients seen within 72 hours of onset, initial conservative therapy failed in 30, of 57 similarly managed and first seen 4 10 days after onset, failure occurred in only 7

The postoperative morbidity was not significantly higher after prompt than after delayed surgery, and the length of hospitalization was much less with prompt operation. Age of the patient and severity of the disease influenced the mortality rate, but duration of chronic disease apparently did not affect the severity of the acute attack. The mortality rate for patients treated within less than 4 days of onset was 6%, from 4 to 10 days of onset, 12.3% and over 10 days after onset, 11.1% Among the patients treated within 72 hours of onset, the rate was somewhat lower with prompt than with delayed operation but in the 4-10 day group it was almost twice as high with prompt operation as with conservative therapy The length of time spent in preparation of patients for prompt operation did not appear to be a significant factor in the outcome

Analysis of the 39 fatal cases revealed that in 19 avoidable delay in operation appeared to be the cause of death No cases were found in which death might have been due to an ill advised prompt operation. Many of the deaths occurring after prompt surgery in the 4-10 day group were due primarily to the advanced stage of the disease at time of admission and operation.

The therapy of choice is now prompt surgical therapy as soon as the patient can be properly prepared except perhaps in some patients first seen 4-10 days after onset In these patients, if the acute attack is subsiding initial

conservative therapy with elective operation a few days later would seem to be the treatment of choice

[The total mortality of 8.3 per cent seems high.—Ed.]

Prevention of Traumatic Injury to Bile Ducts Darvan A. Moosman and Frederick A Coller[1] (Univ of Michigan) dissected the cystohepatic angle of 250 cadavers in order to study the structures of the angle encountered in cholecystectomy and supraduodenal choledochostomy Anomalies of the duct and vascular components of the hepatic pedicle are common. Pathologic changes alter the appearance and position of both normal and anomalous ducts and vessels, and this materially increases the danger of their accidental injury at operation Within the peritoneal fold of the cystohepatic angle are found various structures which are either sought for or should be avoided during cholecystectomy or exploration of the supraduodenal portion of the biliary duct system. A zone 30 mm in diameter in this region was found to contain the following 79% of the cystic arteries, 83% of the right hepatic arteries 85% of the accessory bile ducts and 93% of the aberrant right hepatic arteries The entire course of these vessels or accessory bile ducts is not confined to this half-dollar size area, but an identifiable portion of these structures is to be found within it

The half-dollar size area is surgically important in cholecystectomy during the search for, and ligation of, the cystic artery since the right and aberrant right hepatic arteries are here in danger of being accidentally traumatized or ligated, thus compromising the arterial supply of a portion of the liver One of every five normal right hepatic arteries were found within 1 cm. of the course of the cystic duct, whereas the aberrant right hepatic vessels coursed directly behind it. The ratio of replacing to accessory vessels was over 3 1 Therefore accidental ligation of an aberrant or normal right hepatic artery may well court disaster in a liver whose reserve is already diminished by a pathologic condition.

The incidence of accessory bile ducts was higher than generally reported, and a high percentage of the single ducts coursed somewhere through the 30 mm. zone Their diameter is not inconsequential, and bile leakage from an un

(1) Am. J Surg 82 132 143 July 1951

recognized divided duct is a distinct possibility The deceptive union of the cystic with the common hepatic duct, especially after a parallel or spiral course, should be recognized to avoid overlooking a stone lodged in its distal portion and in estimating the actual length of cystic duct remaining after cholecystectomy Realization of the occurrence and frequency of these anatomic variations should materially reduce the surgical complications based on anatomic aberrations

Surgery of Bile Ducts Rodney Maingot[2] (London) indicates that about 80% of gallbladder and biliary operations are for gallstones or complications produced by gallstones or resulting from operations on gallbladder, bile ducts or duodenum. Mortality in biliary surgery is related to delayed treatment of gallstones and incidence of calculi in the common duct. Exploring the common duct for stone must be considered in every patient operated on for calculous cholecystitis Whenever biliary passages are probed, T tube drainage should be used Indications for choledochostomy are jaundice, colic, dilated or thickened common duct and small stones in the gallbladder If positive or suspicious findings are encountered on palpation of the bile ducts or if bile aspirated from the common duct contains sediment or appears mucopurulent, choledochostomy is necessary Recurrent or relapsing pancreatitis and persistent biliary fistula after cholecystostomy are also indications. If re-exploration for biliary dyskinesia reveals pseudogallbladder the common duct should be explored after excision of the gallbladder remnant. Operative cholangiography is not considered worth while

For choledochostomy essential steps include adequate abdominal incision packing off of stomach, duodenum and colon placing of a long gauze strip into the foramen of Winslow to prevent access of blood or bile to the omental bursa correct positioning of three Deaver retractors and putting the common duct on stretch. The common bile duct cannot be explored satisfactorily through the stump of the cystic duct it is opened between two stay sutures and the common hepatic ducts explored by means of scoops, modified Desjardins forceps and curved pliable suckers" until

(2) Ann. Roy. Coll. Surgeons England 10 97 113 February 1952.

the surgeon is satisfied that they are clear The ampulla is then gently and progressively dilated with graduated Bākes dilators until size corresponds to duct caliber Finally, by means of rubber catheter, led through the incision in the choledochus and guided down the duct into the duodenum, saline is injected to ascertain fluid flow into the duo-

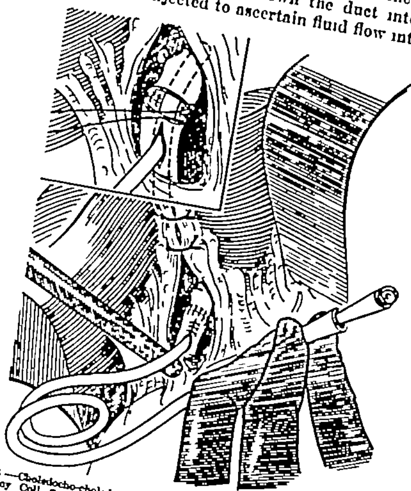


Fig. 146 —Choledocho-choledochostomy and T tube drainage. (Courtesy of Malngot, R. Ann. Roy Coll. Surgeons England 10-97 113 February 1952.)

denum. After further irrigation of the ducts, the common duct is closed around a T tube Occasionally transduodenal choledochostomy will be necessary The T tube is left in 9 10 days

Bile duct strictures are congenital or acquired The acquired type most commonly results from injury at surgery in the right upper quadrant. Other factors predisposing to common duct injury include hemorrhage from the cystic

artery, anomalous cystic or right hepatic artery, carelessness, haste, lack of anatomic knowledge, undue gallbladder traction, subhepatic abscess and distortion of the gastrohepatic omentum, excision of large penetrating duodenal ulcers and variation in anatomic relationships of ducts and vessels. After adequate preparation, operation is mandatory If possible, end to-end anastomosis is the choice (Fig 146) If much of the duct is obscure, the duodenum should be mobilized and the lower portion of the duct found If that does not reveal the lower end of the duct, it is better to anastomose the common or hepatic duct to the loop of proximal jejunum than to the duodenum Anastomosis must be ac curate and without tension. The T tube should never be brought out along the line of anastomosis but through an incision elsewhere in the duct.

Problem of Common Duct Exploration at Time of Cholecystectomy Joel W Baker and Joseph J Koutsky[3] (Seattle) state that the common duct should be explored at primary cholecystectomy for dilatation of the exposed common duct to 1 cm. or more in diameter jaundice, past or present, after proper consideration for increasing incidence of virus hepatitis, and demonstrated diffuse pancreatitis In 379 cholecystectomies, 156 common duct explorations were made and stones found in 20% At surgery 34 patients had jaundice, 6 of them with normal common ducts. Reliable histories of past jaundice were obtained from 18 patients, in 8 of whom ducts were normal on exploration. Freedom from jaundice does not rule out duct stones since only 38 of 76 patients with stones gave a history of jaundice.

All but 4 of 76 patients with duct stones and 12 with fibrosis of the sphincter of Oddi had definite dilatation of the common duct. There were 16 negative but dilated ducts, with the cystic duct plugged by stone in all but 3 the dilatation was probably compensatory to physiologic loss of the gallbladder Such dilated ducts must be explored as cystic duct obstruction does not rule out coexisting common duct stones Four common ducts of normal size contained stones, but 31 of 83 ducts of normal size contained none indicating that size is an important indication for exploration.

(3) West. J Surg 59 495 503 October 1951

Exploration was done in four patients with chronic diffuse pancreatitis without jaundice and in two with receding acute pancreatitis with fat necrosis Twenty two ducts were explored despite normal size because of small stones in the gallbladder and/or colic, 18 contained no stones and 4 had small stones that may have passed through the sphincter of Oddi Because of technical hazard, the common duct was opened to protect it in four cases of cholecystoduodenal fistula and in four instances in which it was difficult to free an impacted cystic duct or Hartman's pouch from the common duct. The only death occurred in this group and autopsy showed that death was due to liver necrosis from thrombosis of the hepatic artery

Postoperatively there was no demonstrated stricture or history suggesting stricture in any of the patients, even where ducts were normal in size during exploration

A fair number of overlooked stones probably escape spontaneously through the sphincter of Oddi after cholecystectomy Of 220 patients without common duct exploration, 5 had postoperative symptoms of colic, and in 1 of these secondary exploration gave negative results

Operative Cholangiography Evaluation of 406 Cases Charles G Mixter Louis Hermanson and Arnold L Segel[4] (Boston) report on cholangiography carried out before opening of the common duct in 260 cases and before closing of the abdomen in 146 All but 20 were technically satisfactory Later improvements in technic lessened failures e g., partial withdrawal of the catheter when it was found in the duodenum.

METHOD—The peritoneum is split down from the ampulla of the gallbladder to the common duct and the cystic duct exposed and ligated at its junction with the gallbladder A no 5 urethral catheter is inserted through an opening just below the ligature and passed into the common duct, avoiding penetration into the duodenum, and tied in place. Diodrast,* 3-5 cc., is injected and an x ray film exposed, then an additional 5-10 cc. is injected and another film exposed. Fractional injections are used to avoid spasm of the sphincter of Oddi which may occur if the ducts are rapidly distended to capacity (12-15 cc.) If the cystic duct is occluded or must be preserved for side-tracking purposes, direct injection into the common duct may be done with a narrow gauge, angulated tonsil needle. While films are being developed, the gallbladder is enucleated.

(4) Ann. Surg 134 346-350 September 1951.

Choledochostomy is checked by cholangiography through the T tube after presumed clearance of the ducts, before abdominal closure. Use of a Bucky diaphragm built into the operating table is advisable. X ray exposures are facilitated by having the patient, under spinal anesthesia, hold his breath.

By avoiding duct exploration, mortality for cholecystectomy is reduced from 3 9 to 0 7% This investigation indicated that 50% of all common duct explorations are unnecessary Symptoms, such as absence of jaundice, cannot be used as criteria for avoiding duct exploration, since Lahey reports that 39% of patients without a history of jaundice were shown to have biliary stones.

Of 113 patients who had immediate cholangiograms and subsequent exploration no pathologic process was found in 35 Furthermore, had the cholangiographic interpretation been accepted by the surgeon 30 of these could have been spared the surgery Of the 147 patients who did not have choledochostomy 131 were followed up 99 were completely well 25 were well but had digestive symptoms, and 7 had had at least one attack of what was probably biliary colic

A normal cholangiogram should be supplemented by aspiration of the common duct since muddy bile or particulate matter indicates need of choledochostomy regardless of the appearance of the cholangiogram Operative cholangiography (1) lowers the incidence of unnecessary common duct exploration, (2) increases the safety of biliary tract surgery through its preliminary meticulous dissection and identification of structures and (3) eliminates secondary operations by demonstrating overlooked common duct stones before abdominal closure

Surgical Decompression in Biliary Obstruction New Operative Procedure is described by Mark A. Hayes and Frederick A. Coller[5] (Univ of Michigan) Remnants of the cystohepatic ducts, which occur in an early developmental period, are utilized as normal duct channels between the liver parenchyma and gallbladder The procedure is of value for decompression in biliary obstruction when cholecystenterostomy cholecystostomy or choledochostomy is impossible (e g., in carcinoma of the common hepatic duct with no proximal uninvolved segment or in inflammatory destruction of the extrahepatic biliary duct system) or to provide drainage preparatory to radical pancreatic surgery

(5) Ann. Surg. 135:98 102 January 1952

In the human embryo of 2.5 mm the liver is a median ventral outgrowth of the entodermal tube, with thick walls which enclose a cavity in wide communication with the alimentary canal According to Felix and Lewis a caudal groove in this diverticulum produces the gallbladder and cystic duct, together with some hepatic trabeculae, and then fuses with the cranial portion Ductal communications between the gallbladder and liver proper are a normal, although temporary, stage in development Subsequent growth and obliteration result in the pattern generally assigned to

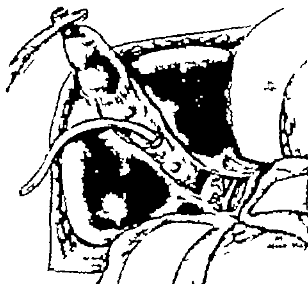


Fig 147 —Operative procedure No definite pathology is shown which produces increase in intraductal pressure since it varies widely One vesicle has been incised and intubated. (Courtesy of Hayes, M. A., and Coller F A.: Ann. Surg 135:98-102, January 1952.)

the extrahepatic biliary system in the adult, although the anomalies of liver and gallbladder communication are present in some persons

The cystohepatic ducts fail to obliterate completely at the gallbladder end of their course The intrahepatic portions, however, remain patent and functioning They are the adult functioning ducts for the segment of the liver in which they are located, though the direction of bile flow is reversed from that of the early embryologic period. These persistent intrahepatic segments will be close to the surface of the gall bladder fossa, along the midline of the fossa in the non fascial area. With progressive obstruction and increased

intraductal pressure, the ends of these ducts in the fossa will appear as elevated vesicles.

TECHNIC.—The gallbladder is mobilized from its fossa in the usual manner, or, if cholecystectomy has been done previously, the line of peritoneal closure of the fossa is reopened Careful inspection of the midline area of the fossa reveals one or several small, elevated, distended vesicles (Fig 147) If needle aspiration reveals bile, the vesicle is incised in a cruciate fashion. The opened duct is explored carefully for depth, direction and caliber with graduated Bakes dilators. A fenestrated polyethylene catheter of suitable size to ensure a snug fit and adequate drainage (no 12-14 F) is inserted far into the duct system and left lying in the gallbladder fossa The peritoneum of the fossa is closed over the catheter which is anchored well to this peritoneum and to the free edge of the liver The catheter is finally brought out through a small stab incision in the abdominal wall

The procedure was done on two patients. One was a woman, 28, with jaundice after cholecystectomy who had stricture of the common duct The jaundice improved postoperatively and a year later a narrow common duct could be seen after lipiodol® injection of the catheter The second patient, 62, had jaundice due to carcinoma of the common hepatic duct which extended into the liver Ten days postoperatively she died of lower nephron nephrosis

Intestinal Biliary Reflux after Anastomosis of Common Duct to Duodenum or Jejunum Experimental Study James E. Musgrove (Albuquerque, N M.), John H Grindlay and Alfred G Karlson[6] (Mayo Found) partially obstructed the common bile duct in dogs at cholecystectomy After 10-12 weeks the dilated common duct was exposed above stricture point and this portion of the duct and the upper intestinal tract were anastomosed side to side In one group the duct was anastomosed to the duodenum, in another to an upper loop of jejunum and in a third group to a Roux Y defunctionalized antiperistaltic loop of jejunum One dog from each group was killed 6 months after anastomosis, the others were killed after 7-30 months.

Hobnailed cirrhotic liver in the only dog with stricture at the biliary intestinal anastomosis strongly indicated that anastomotic stricture, and not enterobiliary reflux, was the main cause of serious liver damage All other anastomoses were widely patent Slight-to-moderate biliary cirrhosis was found in most dogs, although none had

(6) A.M.A. Arch. Surg. 64 670 689 May 1952

jaundice or significant bilirubinemia. Bacteriologic examinations indicated that bile of the gallbladder and common duct tends to remain sterile for some time after the common duct is partially obstructed. After biliary intestinal anastomosis, common duct bile was always invaded by intestinal organisms. Reflux of intestinal content into the biliary tract was demonstrated roentgenologically in dogs with common duct anastomosed either to duodenum or to a loop of the jejunum but could not be demonstrated in Roux Y anastomosis. On the other hand, results of Roux Y

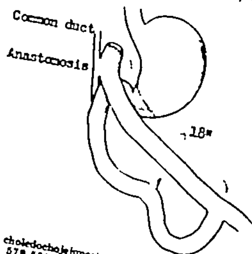


Fig. 148.—Roux Y choledochojejunostomy. (Courtesy of Musgrove, J. E., et al. A.M.A. Arch. Surg. 64: 579-589, May 1952.)

anastomosis, with respect to nutrition, general condition and degree of biliary cirrhosis were not superior to if as good as those of common duct anastomosed to intact jejunum or duodenum. Results were slightly though not significantly better with common duct anastomosed to the duodenum than to a jejunal loop.

Transduodenal Reconstruction of Bile Ducts. Lester R. Dragstedt and Edward R. Woodward[7] (Univ. of Chicago) describe a method for reconstruction of the bile ducts, making use of the intrapancreatic portion of the duct and its normal ostium at the ampulla of Vater. Many cases of obliteration of the bile ducts are not due to direct injury at the time of cholecystectomy but are due to destruction of the bile ducts by the necrotizing effect of the bile that has collected in the peritoneal cavity and pooled near the

(7) Surg., Gynec. & Obst. 94: 53-56, January 1952.

ducts. This view is supported by the fact that the region of the common duct in the pancreas usually escapes this obliterative process.

TECHNIC.—The duodenum is mobilized and the remnant of the

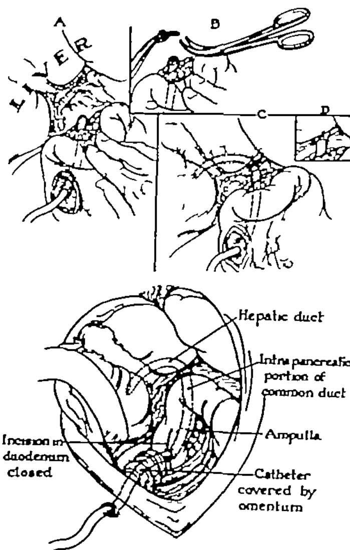


Fig. 149 (top).—*A*, stump of bile duct with catheter. *B*, bile duct transected to open lumen; *C*, catheter pushed upward into hepatic duct; *D*, catheter fixed in place with series of interrupted fine silk sutures.

Fig. 150 (bottom).—Closure of incision in duodenum.

(Courtesy of Dragstedt, L. R., and Woodward, E. R. Surg., Gynec. & Obst. 94:53-56 January 1952.)

hepatic duct exposed. The duodenum should be fully mobilized so that the pancreatic portion of the duct can reach the hepatic remnant without tension. The duodenum is opened and the ampulla exposed. The ampulla is dilated with a graduated sound until it is large enough to admit a rubber catheter. Size of the catheter used

is determined by diameter of the hepatic duct remnant, the catheter should be large enough to fit the duct snugly The catheter is pushed upward through the intrapancreatic portion of the common duct until it enters the remnant of hepatic duct and is fixed in place with a series of interrupted fine silk sutures (Fig. 149) The incision in the duodenum is closed (Fig. 150), or the catheter may be led out through a separate stab wound. The catheter is fastened to the duodenum at this point with a suture of chromic catgut. Omentum is then brought up and wrapped about the catheter and sutured so as to cover the incision in the duodenum. The catheter is finally led to the exterior through a stab wound lateral to the incision. A Penrose drain is placed near the anastomosis with the hepatic duct and removed after two or three days. The catheter is left in place for at least a year to minimize the tendency for subsequent structure at the site of anastomosis. Ill effects from the long continued presence of the tube extending through the ampulla of Vater into the duodenum have not been seen

The procedure was used in three patients in whom the bile duct was more or less completely obliterated and in three with chronic relapsing pancreatitis as a method for preventing bile from obtaining access to the pancreatic duct Results were good in two patients with obstruction of the bile ducts One patient died of biliary peritonitis when the rubber catheter with a hole in it slipped out of the duodenum and discharged bile into the general peritoneal cavity

[It is well that the authors emphasize the desirability of leaving the catheter in place for at least a year. The tendency of scar tissue to contract is apparently only temporary Certainly it is well known that after the scar is covered with epithelium it ceases to contract. In repairing the common duct with a catheter better results will be obtained if the catheter is allowed to remain for at least a year despite the fact that it is a foreign body —Ed.]

Choledochojejunostomy Its Role in Treatment of Chronic Pancreatitis. Ralph F Bowers and Jack Greenfields (V.A. Hosp., Memphis Tenn.) discuss five cases. In view of the recognition of disturbance at the ampulla of Vater as a cause of abnormal flow of bile into the pancreatic duct, a method of safely diverting the bile into the intestine, at a point where it cannot enter the pancreatic duct, was sought through application of the Roux Y principle

TECHNIC.—The jejunum is transected 2 ft. distal to the ligament of Treitz. The common duct is cut where it courses under the pancreas and the distal end ligated with silk. The proximal end of the common duct is anastomosed end to end to the distal jejunal segment in a retrocolic position. The proximal jejunal segment is then anastomosed side to side to the distal jejunal segment 20 in. below

(8) Ann. Surg. 134-99-103 July 1951

ducts This view is supported by the fact that the region of the common duct in the pancreas usually escapes this obliterative process.

TECHNIC.—The duodenum is mobilized and the remnant of the

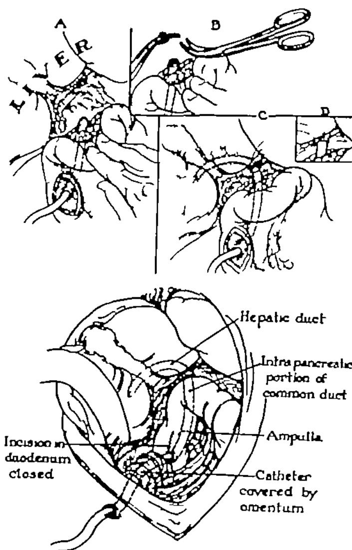


Fig 149 (top) —*A* stump of bile duct with catheter *B*, bile duct transected to open lumen; *C* catheter pushed upward into hepatic duct; *D* catheter fixed in place with series of interrupted fine silk sutures.
Fig. 150 (bottom) —Closure of incision in duodenum.
(Courtesy of Dragstedt, L. R. and Woodward E. R. Surg., Gynec. & Obst. 94:53-56 January 1952.)

hepatic duct exposed The duodenum should be fully mobilized so that the pancreatic portion of the duct can reach the hepatic remnant without tension. The duodenum is opened and the ampulla exposed. The ampulla is dilated with a graduated sound until it is large enough to admit a rubber catheter Size of the catheter used

is determined by diameter of the hepatic duct remnant, the catheter should be large enough to fit the duct snugly The catheter is pushed upward through the intrapancreatic portion of the common duct until it enters the remnant of hepatic duct and is fixed in place with a series of interrupted fine silk sutures (Fig 149) The incision in the duodenum is closed (Fig 150), or the catheter may be led out through a separate stab wound. The catheter is fastened to the duodenum at this point with a suture of chromic catgut. Omentum is then brought up and wrapped about the catheter and sutured so as to cover the incision in the duodenum. The catheter is finally led to the exterior through a stab wound lateral to the incision. A Penrose drain is placed near the anastomosis with the hepatic duct and removed after two or three days. The catheter is left in place for at least a year to minimize the tendency for subsequent stricture at the site of anastomosis. Ill effects from the long continued presence of the tube extending through the ampulla of Vater into the duodenum have not been seen

The procedure was used in three patients in whom the bile duct was more or less completely obliterated and in three with chronic relapsing pancreatitis as a method for preventing bile from obtaining access to the pancreatic duct Results were good in two patients with obstruction of the bile ducts One patient died of biliary peritonitis when the rubber catheter with a hole in it slipped out of the duodenum and discharged bile into the general peritoneal cavity

[It is well that the authors emphasize the desirability of leaving the catheter in place for at least a year The tendency of scar tissue to contract is apparently only temporary Certainly it is well known that after the scar is covered with epithelium it ceases to contract. In repairing the common duct with a catheter better results will be obtained if the catheter is allowed to remain for at least a year despite the fact that it is a foreign body —Ed.]

Choledochojejunostomy Its Role in Treatment of Chronic Pancreatitis Ralph F Bowers and Jack Greenfield[8] (V.A. Hosp Memphis Tenn.) discuss five cases. In view of the recognition of disturbance at the ampulla of Vater as a cause of abnormal flow of bile into the pancreatic duct, a method of safely diverting the bile into the intestine, at a point where it cannot enter the pancreatic duct, was sought through application of the Roux Y principle

Technic.—The jejunum is transected 2 ft. distal to the ligament of Treitz. The common duct is cut where it courses under the pancreas and the distal end ligated with silk. The proximal end of the common duct is anastomosed end to end to the distal jejunal segment in a retrocolic position. The proximal jejunal segment is then anastomosed side to side to the distal jejunal segment 20 in. below

(8) Ann. Surg 134 99 103 July 1951

the choledochojejunal anastomosis to prevent the intestinal contents from ascending and producing cholangitis (Fig 151) A T tube is placed in the common duct, with its lower end coursing through the choledochojejunal anastomosis, it is removed after three months.

Clear bile, uncontaminated by intestinal content, was observed to flow from the T tube, even during the regurgitant phase of early postoperative ileus Cholecystectomy was performed on all but one patient in whom the gall bladder was saved for possible use if the anastomosis had failed to function properly

The five patients were males and heavy drinkers They had had 4-25 attacks of acute pancreatitis before operation.

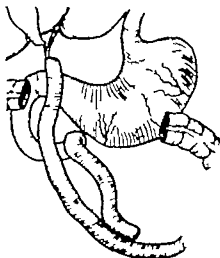


Fig. 151 —Choledochojejunostomy (Courtesy of Bowers, R. F., and Greenfield, J Ann. Surg. 134 99 103 July 1951)

In one patient, serum amylase level fell from 300 mg/100 cc to 190 and 160 two days after operation One patient inadvertently removed the T tube on the tenth post operative day without ill effect. Another who had indulged in heavy drinking postoperatively despite advice to the contrary experienced one mild attack of pancreatitis 10 months postoperatively it responded rapidly to penicillin and gastric decompression There was no evidence of cholangitis postoperatively in any patient. Follow up of 2 months to 1½ years showed all but one patient to be well One man had been killed in an accident, but before this he had considered himself well. Because of the short follow up period, this report must be regarded as preliminary

Sympathetic Nerve Block in Early Acute Cholecystitis
Douglas Eastwood and Nathan A. Womack[9] (State Univ of Iowa) found that in patients with early acute cholecystitis, blocking of the right thoracic sympathetic trunk at the level of the 8th and 9th ganglions immediately relieved pain. Most of the nerve fibers distributed to the biliary tree are derived from the sympathetic system and reach the liver via the celiac plexus The vagal fibers involved come chiefly from the right vagus and pass to the celiac ganglions The hepatic plexus, formed by fibers approaching the liver from the celiac plexus has an anterior and posterior portion. As they approach the region of the common bile duct several large nerves that supply the common bile duct and gallbladder emerge The medial nerve of the gallbladder arises from the anterior plexus, passes over the surface of the common and hepatic ducts anastomoses with the posterior hepatic plexus in the triangle of the cystic and hepatic ducts and passes to the medial surface of the gallbladder The lateral nerve of the gallbladder arises from the posterior plexus and passes along the lateral surface of the common and cystic bile ducts to the lateral and inferior surfaces of the gallbladder Sympathetic fibers may stop in the musculature or extend through and apparently terminate in the mucosa or possibly between the epithelial cells of the mucosa.

Inflammatory changes of the gallbladder produce fibrosis, edema and exudation and result in relative ischemia and stretching of the nerve fibers and trunks There is an additional stimulating effect from inflammatory metabolites such as lactic acid, release of potassium ions and pH changes, varying from intense stimulation of the nerve supply in the acute phase to a lowered threshold of stimulation with periodic exacerbations in the chronic stages

Fourteen patients suspected of having acute cholecystitis were treated with procaine blocks of the right thoracic sympathetic trunk at the level of the 8th and 9th ganglions Ten had immediate and complete relief from pain lasting from 24 hours to several weeks. At operation done one to two days after the injection, subsiding acute cholecystitis was found in six. Another had had a cholecystectomy and had a long cystic duct remnant one had a pyloric ulcer

(9) A M A. Arch. Surg 63 128 131 July 1951

with inflammatory changes in the region of the hepatic plexuses, one had severe hepatic degeneration with cholangitis, and one was not explored because of obesity Of the four who had no relief, one had multiple liver abscesses, one a subphrenic abscess due to previous rupture of the gallbladder and two were not operated on, psychoneurosis having been diagnosed

Vagotomy in Treatment of Biliary Dyskinesia. George Crile, Jr, and D W Miller[1] (Cleveland) point out that postcholecystectomy colic or biliary dyskinesia tends to occur in nervous and hypersensitive persons and can be diagnosed only by exclusion of organic disease. The cause is unknown, but it is supposed by some to be spasm of the sphincter of Oddi. The patient complains of intermittent attacks of colicky pain in the right upper quadrant and epigastrium which may radiate to the scapula and to the right shoulder Since the parasympathetic nervous system through the right vagus nerve maintains tonic control of the sphincter of Oddi, there are theoretical reasons for believing that right vagotomy should relax the spasm which is assumed to be present in biliary dyskinesia.

Nine patients with postcholecystectomy colic were treated by subdiaphragmatic vagotomy Cholangiograms were made on all but one patient, and the diagnosis of biliary dyskinesia was made by exclusion of organic disease Bilateral vagotomy was performed on five patients and right vagotomy alone on four Of the five with bilateral vagotomy, one is well, one has had no more colic but continues to have hypertrophic osteoarthritis which existed before operation one is well except for occasional mild distress due to gastric retention, one was well for 27 months but then had a mild recurrence and one obtained no relief Follow up was for 1¼-3½ years.

One of the four patients treated with right vagotomy alone has had relief from pain for 10 months, but the other three are not improved

In two of the patients who underwent bilateral vagotomy symptoms of gastric retention developed The fact that results of right vagotomy alone were not so good as those of bilateral vagotomy indicates that the left vagus nerve contributes a few fibers to the sphincter of Oddi.

(1) A.M.A. Arch. Surg. 63 687-694 November 1951.

In every case of postcholecystectomy colic without chills, fever or jaundice, the possibility of biliary dyskinesia should be kept in mind If the pain is continuous and well localized, procaine should be injected into the abdominal wall at the site of the pain to rule out a somatic origin in the cholecystectomy scar or in intercostal neuritis. When ever possible, symptoms should be controlled by medical or psychiatric therapy If medical treatment fails and no other cause for pain can be found, and if the attacks are severe, a cholangiogram should be made on the operating table and vagotomy tried

[This will be a fine contribution to a difficult problem if subsequent results are as good as those reported so far.—Ed.]

Right Splanchnicectomy in Hypotonia of Biliary Tract is discussed by P Mallet Guy and L. Durand[2] This diagnosis may be suspected on inspection of cholecystograms and when intense digestive difficulties in the presence of stones cannot be attributed to the stones alone It is best confirmed, however, by manometric and radiologic studies during laparotomy Right splanchnicectomy is indicated only after medical treatment has failed. Provided the semilunar ganglion is left intact, this procedure improves the tone of the biliary passages and sphincters. Of 135 patients undergoing this procedure results were perfect in 51.8%, good in 30.4%, with improvement in 5.2% Relapses were occasionally seen during the first year but after three years the condition remained stationary In 12.6% results were poor due to associated organic or emotional factors, poor technic (injury to the semilunar ganglion) and biliary hypertonia

Cholecystography in some patients showed return of normal gallbladder tonus and its normal evacuation after a test meal. Manometric and cholangiographic studies in one patient with biliary drain also showed improved tone. In six patients, the effects of splanchnicectomy were well demonstrated by these studies at the time of a second operation. In two patients who had had cholecystectomies 12 and 37 months before there was return of normal evacuation pressure and good functioning of the sphincter of Oddi on cholangiography Normal biliary tonus was also found in the four whose gallbladder had been preserved.

(2) Lyon chir 46 791-804 October 1951

Nonmalignant Intrinsic Stricture of Pancreatic Duct Lyon H. Appleby[3] (Vancouver, B C) reports a case of idiopathic benign stricture of the pancreatic duct within the substance of the head causing chronic retention and distention of the duct radicals

Man, 50, had had diarrhea for two to four months every second year since 1939, diffuse pain in the upper part of the abdomen cramps at stool and recent weight loss of 10 lb X rays revealed normal stomach and gallbladder The duodenal cap was large and dilated and there was a persistent filling defect in the distal portion of the cap which was either intrinsic or extrinsic. Tentative diagnosis was neoplastic disease of the head of the pancreas or the second portion of the duodenum.

Operation showed the duodenum edematous and the pancreas hard. The common duct was normal. In transection of the neck of the pancreas there was a rush of pent up pancreatic fluid. Probes could enter the bile duct with ease through the ampulla but could go only ⅜ in. into the pancreatic duct, where there was a definite stricture. The stricture was dilated from the pancreatic end of the duct to an 8 mm. size by DeBakey dilators, and a rubber tube was passed through the ampulla of Vater, through the duct and into the ducts in the tail of the pancreas. The neck of the pancreas was reanastomosed over the indwelling rubber tube, which was anchored to the duodenum with plain surgical gut. The tip projected through the ampulla into the third part of the duodenum. The duodenum was then closed and the gallbladder anastomosed to the jejunum. Biopsy of the pancreas revealed chronic pancreatitis.

Postoperatively, the diarrhea stopped and the patient gained weight. X ray study eight months later showed that the tube had passed out unrecognized Laboratory studies showed that the gall bladder was not obstructed and that the pancreas was functioning normally

Annular Pancreas J R Anderson and H. Wapshaw[4] (Western Infirm., Glasgow) reports a case of annular pancreas in which the presenting symptom was jaundice apparently due to pressure on the lower end of the common bile duct by the inflamed pancreatic annulus Fifty two cases have been reported in the literature In 14, the constriction caused severe symptoms, necessitating surgery in 2, acute pancreatitis was a fatal complication.

Woman 32, was hospitalized with abdominal pain vomiting and jaundice. She had had two similar attacks of pain during the year

(3) A.M.A. Arch. Surg. 63 116 118, July 1951
(4) Brit. J Surg. 39 43-49 July 1951

once with jaundice. Temperature was 102 F The abdomen was tender, the stools were acholic, and the urine contained bile. Jaundice and symptoms disappeared in five days. Cholecystography failed to demonstrate the gallbladder and the serum amylase level was normal during the third week of illness. Intermittent biliary obstruction due to gallstones was diagnosed and laparotomy done. The gallbladder was normal, no stones were felt, but the cystic and common bile ducts were greatly dilated and an annular pancreas was found. The annulus resembled a signet ring and was about 1.5 cm wide anteriorly, 2.5 cm. wide posteriorly and 1 cm. thick. The ectopic tissue was nodular and firm it completely encircled the second part of the duodenum but did not cause obvious constriction

The common bile duct was patent. A segment of the ring was resected without difficulty, although most of the outer muscle coat had to be sacrificed because of adherence to bowel wall. Convalescence was essentially normal. Cholangiography 14 days after operation showed an incomplete obstruction at the distal end of the common duct. With a barium meal, an obstruction with smooth, rounded out lines was seen in the second part of the duodenum.

Histologic study of the piece of pancreas revealed acinar loss with replacement by fibrous tissue, indicating repeated attacks of subacute pancreatitis Jaundice was due to compression of the common bile duct during more active phases of pancreatitis X ray evidence of obstruction to the first and second parts of the duodenum confirms the diagnosis

Relief can be obtained by a direct attack on the annulus or a short-circuiting procedure Partial resection of the pancreas carries the danger of a pancreatic fistula Cholecystojejunostomy was considered in this case, but it was thought best not to expose the liver to infection.

The normal pancreas develops from two outgrowths, one dorsal and one ventral, from the part of the gut destined to become the second part of the duodenum The dorsal outgrowth forms the tail, body and all but the lower right quadrant of the head of the pancreas The ventral outgrowth consists of two buds arising one from either side of the common bile duct in human beings the left bud normally atrophies and disappears, whereas the right one persists. As the gut enlarges and rotates the ventral anlage, with the common duct, migrates dorsally around the right side of the bowel and fuses with the dorsal analage to form the remaining part of the head of the composite organ, which by further rotation comes to lie to the left of the second part of the duodenum. Each pancreatic outgrowth has a single main duct and these also unite That of the

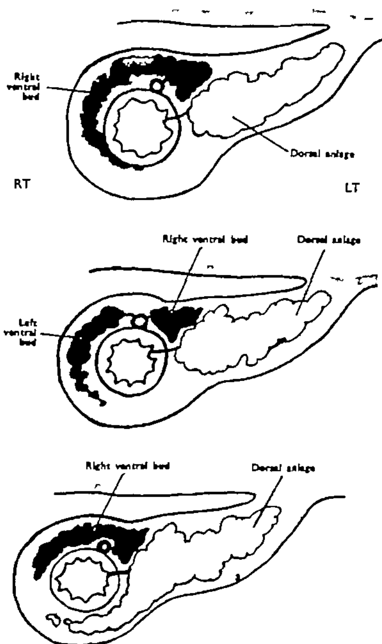


Fig. 152 (top) —Annulus resulting from adherence of right ventral bud near its point of origin (Lecco's theory)

Fig. 153 (center) —Annulus resulting from persistence and enlargement of left ventral bud, with duct of annulus entering common bile duct (Baldwin's theory)

Fig 154 (bottom) —Annulus resulting from extensions of both right ventral and dorsal anlagen (Tieken's hypertrophic theory) This does not explain usual duct arrangement.

(Courtesy of Anderson, J R. and Wapshaw H. Brit. J Surg 39 43-49 July 1951)

dorsal anlage persists as the main duct which traverses the tail, body and part of the head, where it becomes confluent with the duct of the ventral anlage, which contributes the terminal part of the main duct. This explains the S-shaped course taken by the duct of Wirsung through the head of the pancreas. The dorsal anlage may retain its original connection with the duodenum through the accessory duct of Santorini, which emerges proximal to the ampulla of Vater. Three theories concerning the development of annular pancreas are depicted in Figures 152-154.

In 17 of 20 cases of annular pancreas in which the duct system has been studied, the annulus had a single main duct which originated in the portion of the ring overlying the left anterior surface of the duodenum, then swept dorsally around the right side of the duodenum, crossed the gut posteriorly from right to left and opened into the main pancreatic duct close to the ampulla.

Since most annular ducts originate over the left anterior part of the duodenal wall, and the annulus is itself attentuated at this site, that part overlying the left anterior surface of the duodenum is the site of election in performing incision or resection of the ring.

Acute Pancreatitis and Its Treatment. Mims Gage and George Gillespie[5] (New Orleans) state that acute pancreatitis is a chemically rather than bacterially produced inflammation, except when associated with certain virus diseases. In most cases it is caused by regurgitation of bile from the common bile duct, gallbladder or both into the pancreatic ducts under sufficient pressure to rupture the interlobular ducts and acini. The highly toxic fluid escapes into the interacinous spaces and lymphatics, setting up a sequence of events resulting in local necrosis of the cellular tissue, blood vessels and fat, hemorrhage, formation of fatty acids and spasm of the ducts and blood vessels. There is a great demand for calcium to neutralize the fatty acids. This acute chemical reaction may be aborted at the edematous stage or may continue to the hemorrhagic, necrotic and gangrenous stage, depending on whether the obstruction at the sphincter of Oddi is relieved. The demand for calcium may be so great that tetany may rapidly develop and result in death from acute calcium deficiency.

(5) South. M. J. 44: 769-775, September 1951.

The first symptom, sudden unbearable epigastric pain, is followed by nausea, vomiting, increased pulse rate, shock of varying severity, mild to moderate rigidity of abdominal muscles, abdominal tenderness, cyanosis of the face and bluish patches on the abdomen with extreme prostration. Ileus of the duodenum and upper portion of the small intestine occurs in the moderately severe and severe types. There is usually elevated blood amylase and elevated sedimentation rate

Treatment by drainage of the pancreas and extrahepatic

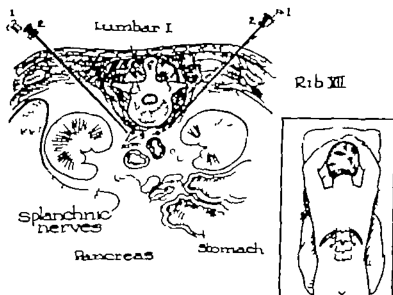


Fig 158—Bilateral splanchnic block, showing contact of spinal puncture needle with body of first lumbar vertebra (dotted needle) and introduction of needle into lumbar cellular tissue (block needle); inset, patient in prone position. (Courtesy of Gage, M., and Gillespie G: South. M J 44 769-776 September 1951)

biliary tract results in mortality rate of 50-80% and diabetes occurs in 2-3% of those who recover

There were no deaths in 30 patients treated conservatively This therapy consists of gastrointestinal drainage to relieve the ileus, nothing by month, glucose and saline infusions, blood transfusions, calcium intravenously to neutralize fatty acids and combat spasm of the neuromuscular tubes and bilateral block of the splanchnic nerves with 20-30 cc. of 1% solution of procaine hydrochloride to relieve the obstruction of the ampulla or the papilla of Vater and eliminate spasm of the ductal and blood vascular systems.

TECHNIC.—With the patient prone and a pillow beneath the epigastrium, the spinous process of the first lumbar vertebra is identified 7 cm. lateral to this spot, a long spinal puncture needle is inserted down near the twelfth rib until the body of the first lumbar vertebra is contacted. The needle is slipped off the body of the vertebra and introduced for 2-3 cm., its end entering the lumbar cellular tissue where the splanchnics are located. The syringe is then aspirated to determine whether a vessel has been perforated if it has, the needle is withdrawn and reintroduced. Injection of 20-30 cc. of 1% solution of procaine hydrochloride into the retroperitoneal tissue bathes the splanchnics and anesthetizes those on the right and left sides. Extreme care should be exercised to avoid injecting the procaine into the blood stream.

Within 20 minutes after the block the patient is dramatically relieved of the agonizing pain and appears relaxed and comfortable Once the block is relieved, the pancreas and extrahepatic biliary systems empty themselves of the necrotizing enzymic digestive fluid into the duodenum, where it does no damage to the intact mucous membrane Surgical correction of the concomitant disease of the gallbladder and extrahepatic ducts should be postponed at least one to two months until the patient has completely recovered from the acute phase and the sedimentation rate has returned to normal.

The efficacy of splanchnic blocks has been demonstrated in dogs after injection of bile into the pancreas.

[It is remarkable how completely ideas have changed about the emergency nature of acute pancreatitis. Only a few years ago it was considered to be a condition demanding immediate laparotomy.—Ed.]

Is Reflux of Bile into Pancreatic Ducts Normal or Abnormal Physiologic Process? Visualization of the pancreatic and biliary ducts by operative and postoperative cholangiograms revealed three distinct varieties of duct system. N. Frederick Hicken and A. James McAllister[6] (Univ. of Utah) injected diodrast* into the biliary systems of 100 patients, 80 times at operation and 50 times postoperatively In 30% the choledochus and duct of Wirsung united at the ampulla of Vater in 57% the choledochus and duct of Wirsung united at the common papillary orifice to empty their contents into the duodenum in 13% the bile and pancreatic ducts emptied into the duodenum through separate stomas Reflux of the radiopaque material into the pancreatic duct was demonstrated not only in the ampullary type but also in the other two types This is contrary to previous teach-

(6) Am. J. Surg. 83:781-786, June 1952

ings. There is no doubt that bile could and would traverse the same patent channels Dye was injected into bile ducts under normal ductal pressures Although every patient had sufficient pathologic disturbance of the biliary system to necessitate surgical exploration, they are representative of what normally occurs in the anatomic and physiologic inter relations of the two systems

In patients with choledochal stones, pancreatic ducts were visualized by the refluxing contrast solution, in no patient were ductal systems completely obstructed despite removal of as many as 36 stones from the larger bile ducts. Elevation of intraductal pressures or spasm of the sphincter of Oddi was not noted When pancreatic duct reflux could be demonstrated, biopsy of the uncinate process of the pan creas was taken. In only three instances did the pathologist find sufficient morphologic changes to warrant diagnosis of acute or subacute pancreatitis This was true even with acutely inflamed biliary tract. Apparently the reflux of bile into the pancreatic ducts is a normal physiologic process and seldom produces inflammatory changes within the pan creas

[So far as the editor is concerned this study makes more confusing than ever the idea that acute pancreatic necrosis is due to reflux of bile in the duct of Wirsung. When this idea was first proposed by Opie about 50 years ago the autopsy finding of an obstructing gallstone in the papilla of Vater in his case seemed to make the idea a reasonable one under such conditions. It has always seemed difficult, however to understand why without an obstruction of some kind such as a stone, suddenly after 50 years or so of life a reflux would occur and produce acute pancreatitis. Isn't something more than a reflux necessary as suggested by Hicken and McAllister? Perhaps a change in the character of the bile is necessary although many investigators have claimed that at least in the dog the injection of apparently normal bile into the pancreatic ducts will produce extensive necrosis. Where do we go from here?—Ed.]

Role of Trypsin in Pathogenesis of Acute Hemorrhagic Pancreatitis and Effect of Antitryptic Agent in Treatment. Benjamin Rush Jr., and Eugene E Clifton[7] (Yale Univ) noted changes in amylase, proteolytic and antiproteolytic titers as well as blood pressure in dogs with experimental acute pancreatitis Five of six dogs died after pancreatitis was induced. They showed deep shock with elevated proteolytic titer and sharply lowered serum antiproteolytic activity In the survivor blood pressure dropped to shock level, then returned to normal. Proteolytic activity rose

(7) Surgery 31 349 360 March, 1952

moderately and antiproteolytic activity dropped somewhat.

Three dogs had intravenous injections of 2% solution of soybean trypsin inhibitor (SBI) which inhibits proteolytic action trypsin. One received too much SBI and died Two, with proper amounts of SBI after induced pancreatitis, rapidly regained normal blood pressures. Proteolytic and antiproteolytic activities were maintained at normal levels In one dog antiproteolytic activity of the serum was increased One dog observed for over 12 hours showed pronounced but only transitory clinical improvement compared to dogs not given SBI SBI was highly anticoagulant for several hours. Postmortem studies of dogs dying of pancreatitis, including those injected with SBI showed diffuse hemorrhagic and extensive fat necrosis of the pancreas

Rise in spontaneous proteolytic activity of the serum in acute hemorrhagic pancreatitis may result from active trypsin released from the injured pancreas or from transformation of serum plasminogen (proteolytic enzyme precursor) into the active form plasmin. As proteolytic activity increases, the antiproteolytic factor of serum would be expected to offset it to preserve normal level Level of antiproteolytic activity is residual after equilibrium is reached with trypsin released from the injured pancreas and/or plasmin produced by activation of plasminogen in the serum

Introduction of trypsin into the circulation from the pancreas and reduction of antiproteolytic factors in serum as a result of added trypsin both contribute to shock in acute pancreatitis

Activating plasminogen with staphylokinase in vivo indicates that some increase in proteolytic activity is due to activation of the serum proteolytic enzyme

Since SBI specifically counteracts elevated proteolytic activity and shock in acute pancreatitis in dogs its potentialities as specific clinical treatment of shock in acute hemorrhagic pancreatitis may be considerable

Metabolic Effects of Total Pancreatectomy in Man. A. G W Whitfield, A. Gourevitch and Garfield Thomas[8] (Univ of Birmingham) studied the protein and fat absorption, insulin requirements and blood picture of a man, 65 who has survived total pancreatectomy for over two years. With 15 Gm. pancreatin daily fat absorption was

(8) Lancet 1 180-183 Jan. 26 1952.

38%, and with 11.5 Gm., 83% Without pancreatin there were three bulky and ill formed stools daily When pancreatin was given the stool decreased in bulk and had a more normal consistency, but there was only slight reduction in frequency

Pancreatin did not improve the nitrogen balance, in fact, it appeared to reduce the amount absorbed. This failure to reduce fecal nitrogen and improve nitrogen balance cannot be explained.

Only a small amount of insulin was needed to control diabetes despite a high carbohydrate intake With a 180 Gm. carbohydrate diet, the daily insulin requirements were between 20 and 40 units with a 240 Gm. carbohydrate diet, they were 48-60 units The patient has had mild hypoglycemic reactions occasionally but these have not been more remarkable than in ordinary diabetes

Blood study showed slight macrocytic anemia There was moderate leukocytosis, probably due to splenectomy and postoperative ascending cholangitis The macrocytic anemia may be due to liver damage after recurrent cholangitis

Studies in Pancreatic Function IV Use of Secretin Test in Diagnosis of Tumors in and about the Pancreas David A Dreiling[9] (Mount Sinai Hosp New York City) found that tumors of the pancreas encroaching on the pancreatic ducts cause alteration of external pancreatic secretion, which characteristically is diminution of the volume response to secretin. In the quantitative test of pancreatic function based on analyses of the duodenal contents following intravenous injection of secretin the total volume, bicarbonate concentration and amylase concentration and total amylase secretion characterize the pancreatic response to secretin Biliary pigment response is a measure of the biliary flow into the duodenum following secretin injection.

The decrease in volume of pancreatic secretion present in 58 of 61 patients with proved pancreatic tumors, depends on the degree and site of obstruction. In general, tumors toward the head of the pancreas produce the greatest abnormalities because they obstruct larger ducts Tumors of the tail usually do not alter the secretion.

The decrease in total amylase secretion is proportionate to the diminution of volume and extent of destruction of

(9) Gastroenterology 18 184 196 June, 1951

acinar tissue The bicarbonate depression tends to be minimal. Abnormal values for amylase and bicarbonate occur mainly with tumors that involve the pancreas diffusely These abnormal values may also be an expression of the chronic pancreatitis so often associated with these tumors

Diminished pancreatic flow when jaundice is present implies a neoplasm of the head of the pancreas. Rarely, a common duct stone with obstruction to the duct of Wirsung gives similar results Obstructive jaundice with normal pancreatic secretion indicates a lesion in the extrahepatic ducts The secretin test is thus useful in localization of disease in patients with surgical jaundice

Diabetes mellitus is a frequent concomitant of pancreatic malignancies Diabetes per se does not alter pancreatic secretion, and abnormal secretin responses in a diabetic are presumptive evidence of pancreatic tumor or pancreatitis. Tumors contiguous to the pancreas do not alter pancreatic secretion.

Further Considerations in Internal Drainage of Pancreatic Cysts David Henry Poer and William G Whitaker[1] (Emory Univ) maintain that the etiology and pathology of pancreatic cysts other than those caused by neoplasm, have little surgical interest Abdominal trauma and pancreatitis are frequently associated with pancreatic cysts. Diagnosis is suggested by the triad of upper abdominal pain, pressure symptoms from adjacent organs and palpable mass. X ray study will reveal displacement of hollow viscera.

Three methods of surgical treatment may be employed. Total excision is performed whenever possible and is useful for small cysts it can only be used in a fraction of operations because of technical difficulties. Marsupialization or drainage to the exterior by catheter is technically easy but has the disadvantage of excoriating the surrounding skin the drainage tract tends to close, allowing the cyst to recur Internal drainage by anastomosis of the cyst to some portion of the gastrointestinal tract, most commonly the jejunum, gives adequate drainage prevents persistence of draining external fistulas with skin excoriation and utilizes external pancreatic secretion in the alimentary tract. Anastomosis may be made without interrupting continuity of the gastrointestinal tract by suturing the cyst wall to the side of

(1) Ann. Surg 133 764 771 June 1951

the bowel, taking care to establish a stoma at least 4 cm. in diameter The objection that food particles, bile or intestinal juices may enter the cyst causing reinfection or reactivation of inflammatory processes may be circumvented by using a Roux Y type of anastomosis, in which a defunctionalized segment of jejunum, 10-20 cm. long is fashioned

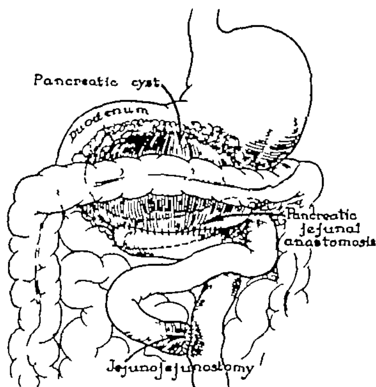


Fig. 156—Internal drainage of pancreatic cyst using Roux Y method of anastomosis to jejunum. (Courtesy of Poer D H., and Whitaker W G Ann. Surg. 133 764 771 June, 1951.)

and end to-side anastomosis performed between the cyst and the end of the jejunal segment (Fig 156)

Internal drainage was used in three patients. One had had recurrence of pancreatic cyst after apparently successful marsupialization, internal drainage using the stomach resulted in no further difficulty in nine years The second had a problem of prolonged external drainage with recurrence of abdominal pain and mass, after cystojejunostomy the patient was asymptomatic for nine years The third, followed for 18 months after cystojejunostomy has shown excellent results

Surgical Considerations on Treatment of Pancreatic Cysts by Internal Drainage According to Basilo Kourias[2] (Athens) among internal anastomoses those to the stomach are preferable at least for cysts localized in the body or tail of the pancreas, since the operation is simple and indicated by anatomic relations. In cysts of the head of the gland, anastomosis with the pyloric antrum may favor continuous reflux of the gastric content into the cystic cavity so that healing becomes impossible and a Roux Y anastomosis with a defunctionalized loop of jejunum is preferred. In case of failure of internal drainage into stomach, duodenum or gallbladder it is best to replace this anastomosis as soon as possible with a new one with the jejunum, as in the reported case Anastomosis with the gallbladder has been abandoned, that with the duodenum is indicated by the topography in exceptional cases, but regurgitation into the cystic cavity cannot be excluded. In anastomoses of all types it is important to place the patient prone during the first few days after operation since this facilitates continuous evacuation of cyst and consequently its retraction.

Man, 42, had had marsupialization of pancreatic cyst 16 months before hospitalization Six months later a gastrocystic anastomosis was made because of relapse but improvement was only transient. The patient was weak and anemic temperature was 37.5-38 C At laparotomy the large cyst of the head of the pancreas and its gastric anastomosis, 7 cm. wide, were easily exposed. The adjacent wall of the duodenum was flattened, inflamed and fragile the inflammatory process extended to the middle of the pancreas. The anastomosis was divided and 60 cc. fluid aspirated from cyst and sodium morrhuate injected into it. Its excision was difficult because of intimate adhesion to the duodenum a Roux Y anastomosis was therefore performed Postoperative course was smooth, anemia disappeared general condition became excellent and continued so 14 months after operation.

Carcinoma of Body and Tail of Pancreas Report of 37 Cases Studied at State of Wisconsin General Hospital from 1925-50 is presented by Burton K. Smith and Edwin C Albright[3] (Univ of Wisconsin) The head of the pancreas was not involved. Autopsy was done in 24 cases duration of the disease in these was 9.1 months. Men comprised 84% of the patients Average age was 58.1.

The primary tumor, lying in the midpancreas where it

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(2) J chir 68 266-275 April, 1952.
(3) Am. Int. Med. 36-90-97 January 1952.

can erode into the celiac plexus, gives rise to deep gnawing pain. The common symptoms are (1) abdominal pain (97%), aggravated by the supine and relieved by the erect position (43%) and sometimes radiating to the back, (2) weight loss (97%), (3) anemia (81%), usually hypochromic, (4) constipation (51%), and (5) nausea and vomiting (46%) Ingestion of food caused aggravation of pain in 33% of patients Gastrointestinal x rays were usually negative Ascites occurred in 32%, usually late in the disease, in all these liver metastases with peritoneal implants or portal vein thromboses were found at autopsy or laparotomy Epigastric tenderness was present in 38% Diabetes was found in only three patients

Venous thrombi, usually in the femoral and iliac veins, were noted in 30% of patients, being multiple in 22% This figure is somewhat lower than the percentages reported by others Venous thrombosis may comprise an early sign of the disease The tumor cells are believed to interfere with the blood-clotting mechanism

[Multiple venous thrombosis is one of the most remarkable characteristics of this condition. The first sign of the disease often is thrombosis of a vein in the leg or arm. At present there is no explanation of this strange phenomenon.—Ed.]

SMALL INTESTINE

Duplications of Alimentary Tract are spherical or tubular structures whose walls contain well developed muscular layers and whose lining is a mucosa similar to that of some part of the alimentary tract. They should not be confused with mesenteric lymphatic cysts or anomalies arising from Meckel's diverticulum. Robert E. Gross, George W Holcomb, Jr., and Sidney Farber[4] (Children's Hosp., Boston) believe that the most plausible theory for the origin of these duplications is that proposed by Bremer In the embryo of about six weeks the lumen of portions of the intestinal tract may become completely occluded by rapid proliferation of epithelial cells. Vacuoles begin to appear in this cell mass as the intestinal tract grows in length. After these spaces form, they coalesce and usually arrange themselves in longitudinal rows parallel to the long axis of the

(4) Pediatrics 9 449 468, April, 1952

bowel. Eventually, all such isolated vacuoles join one another to produce the normal lumen of the intestine Persistence of one of these hollow spaces can lead to formation of a duplication which develops all muscle layers of the intestinal tract and may possess a common wall with the bowel or may hang free on its own mesentery (Fig 157)

The sites of 68 lesions in 67 children are shown in Figures 158 and 159 Duplications assume various shapes At the operating table spherical lesions are usually recognized readily, but occasionally a long tubular duplication may be

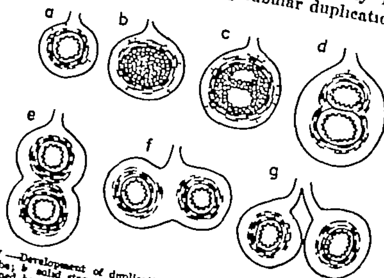


Fig. 157 —Development of duplication of alimentary tract *a* early stage of alimentary tube; *b* solid stage *c* two vacuoles in cell mass *d* two epithelial lumens with conjoined basement membranes *e* conjoined circular muscle layers between hollow structures *f* same in horizontal position which can progress to (*g*) free duplicate tubes, each with complete intestinal wall and separate mesentery (Redrawn from J L. Bremer) (Courtesy of Gross, R. E., *et al* Pediatrics 9:449-468 April, 1952.)

so incorporated in the intestinal or colonic wall that no abnormality is suspected. Rounded duplications vary in diameter from 1 to 10 cm. or more, and tubular structures as long as 65 cm. have been found A communication was discovered between the duplication and alimentary tract lumen in only 13 instances (19%) Duplications found in the mesenteric leaves can be distinguished from mesenteric cysts without much difficulty Simple lymphatic cysts are thin walled, flabby loosely adherent to any surrounding structures and lined by flattened endothelial cells and a thin layer of fibrous connective tissue Duplications usually have walls about as thick as the adjacent bowel and microscopically there are various layers resembling the structure of

esophagus, stomach, intestine and colon If there is no communication to the bowel, the fluid found in a duplication is usually clear, colorless and often mucoid.

Of the 67 children, 54% were boys Ages ranged from 1 day to 13 years. Twenty-one children had associated anomalies Symptoms produced by the lesions varied ac-

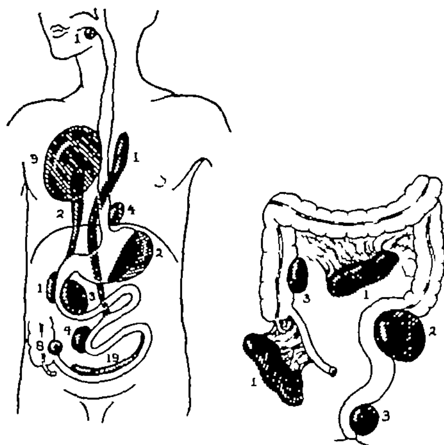


Fig 188.—Distributions and general shapes of 64 duplications of alimentary tract Figure beside each lesion indicates number of duplications found at that general site (Courtesy of Gross, R. E. *et al.* Pediatrics 9 449-468 April, 1952)

cording to their location, size and type of fluid secreted by the mucosa

Duplications should be operated on as soon as feasible The procedure of choice varies according to the location of lesion and circumstances attending it. A duplication arising within the thorax is treated by transpleural, complete excision. The extent of surgery for thoracic duplications arising below the diaphragm depends on the symptoms and

type of membrane lining the duplication Gastric duplications are probably best treated by excision of as much of the lesion as possible and the cutting away of residual mucous membrane from any portion of the duplication that remains For small intestine lesions the method advocated

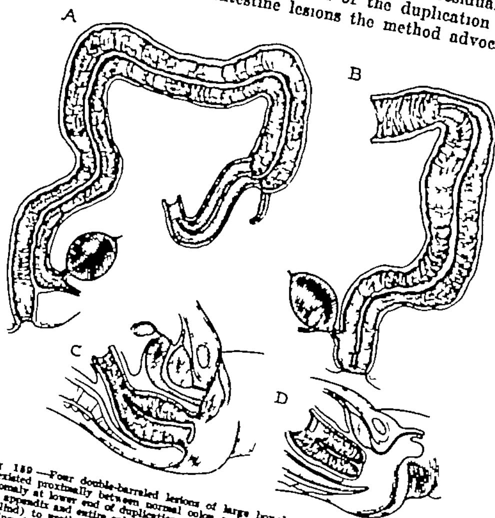


Fig 189 —Four double-barreled lesions of large bowel. In each, free communication existed proximally between normal colon and extra tube Symptoms were caused by anomaly at lower end of duplication. *A* patient had situs inversus double terminal ileum, appendix and entire colon, with fistula from one rectal pouch (which was otherwise blind) to urethra. *B* rectourethral fistula in patient with double large intestine extending from splenic flexure almost to anus. *C* extra rectal orifice discharging feces, anterior to normal anus. *D* duplication and normal rectum ending as imperforate structures. (Courtesy of Gross, R. E., *et al* Pediatrics 9 449-468, April 1952)

by Gardner and Hart is adequate, i.e., removal of a portion of the wall which lies toward the duodenum, thus creating a large opening between the two cavities Right colectomy followed by ileocolostomy should be done for lesions arising at the ileocecal valve or in the cecal wall. In a double-lumened colon or rectum, only the lower end of the anomaly,

the part that gives rise to symptoms, need be attacked. In the present series, the mortality was high for children treated before *1940*, none of *20* treated in the last four years has died.

Nonspecific Ulcer of Small Intestine Patrick C Shea, Jr[5] (Emory Univ) reports on five patients, aged 19, 34, 39, 48 and 80, of whom four were acutely ill and three had perforation of the small intestine Symptoms had been present for 6 hours to 12 days Chief symptoms were nausea, vomiting and nonlocalized, persistent abdominal pain, sudden in onset and occasionally colicky None had melena or hematemesis The patients had fever on hospitalization, usually leukocytosis, abdominal distention with tenderness and rectal and rebound tenderness Roentgenologic studies of the abdomen had no diagnostic significance One patient with chronic illness had a history of melena and considerable weight loss She had been observed over nine years. In the *eighth year radiologic studies of the gastrointestinal tract* indicated a contracted area of jejunum with dilatation behind that area Jejunal ulcer was tentatively diagnosed. This was the only instance in which preoperative diagnosis was correct.

Surgery has been the only successful treatment for this lesion Four of these patients, two with intestinal perforation, had resection and establishment of an end to-end anastomosis All recovered Transverse closure was used in one instance of perforation but the patient died of pulmonary embolism. All five were routinely prepared for surgery by Levin intubation with Wangensteen suction and blood and fluids intravenously when indicated

Intestinal Obstruction. *Paul Nemir, Jr [6] presents a statis*tical study of 430 cases of intestinal obstruction seen at the Hospital of the University of Pennsylvania from 1940 to 1950 Treatment was surgical in 358 and conservative in 72 Operation mortality was 10% Adhesions external hernias and malignancy accounted for 84.6% of the obstructions in the surgical group and 83 3% of the deaths. Although malignancy was the cause of obstruction in only 23 5% of *the cases in this group it accounted for* 47 3% of the deaths. Simple obstruction was present in 74 7% and causes 66 6%

(5) J A. M. A. 146 1490-1492 Aug 18 1951
(6) Ann. Surg. 135 367-375 March 1952

of the deaths Strangulation was seen in 17 3% and caused 84% of the deaths Strangulated gangrenous gut was found in only 8 1% of the cases, but 25% of the deaths were in this group

There were 227 cases of acute complete obstruction with a mortality of 7.5% Although gangrenous gut was found in only 13% of these cases, it accounted for 53% of the 17 deaths. There were 142 cases of intestinal obstruction due to adhesions and stricture with a mortality of 7%, in 73% the adhesions or strictures were secondary to previous surgery In 90 cases of external hernia mortality was 5 5% The mortality in cases in which resection was necessary was 37.5% In this group all the patients who died were females, and average duration of symptoms was 130 hours

There were 84 cases of intestinal obstruction due to malignancy with a mortality of 20.2% In 18 cases in which obstruction was due to carcinomatosis, there were 7 deaths The mortality in nine cases of obstruction due to internal hernia was 22.2% Of 13 cases of volvulus, with no deaths, 11 were due to postoperative adhesions 1 to sigmoid volvulus and 1 to malrotation of the gut Gallstones caused obstruction in five cases and fecal impaction in two with one death in the latter In seven cases due to intussusception there was one death. Other causes of obstruction included congenital anomaly stricture of the splenic flexure and prostatic metastasis to the liver

Obstruction developed in the immediate postoperative period in 27 cases and necessitated another operation. In 19 it was due to adhesions and in 3 to strictures, in 3 there was a volvulus due to adhesions in 1 a cecostomy failed to function and in 1 an internal hernia developed. Seventeen of the patients with obstruction due to adhesions recovered.

Mortality was 8.3% in the 72 cases in which treatment was conservative Patient mortality was 10 7% since only 56 patients comprised the 72 admissions Most of the patients had had previous operations for obstruction or carcinoma

There was no decrease in mortality from 1945 to 1950 when penicillin and other antibiotics were in common use Peritoneal fluid which grossly resembled that seen in the experimental animal subjected to strangulation obstruction was found in the peritoneal cavity of 8 to 12 patients who died of gangrenous bowel and could have caused death.

Reduction of Intussusception by Barium Enema is not new Hirschsprung in 1876 improved on contemporary mortality for intussusception by using hydrostatic pressure. Mark M. Ravitch and Russell H. Morgan[7] (Johns Hopkins Univ) report on use of barium enema since 1946 In 57 intussusceptions primary treatment was barium enema for all but two patients successfully operated on for other reasons. No deaths resulted. Of the 57, 42 were reduced by barium enema alone, 15 required operation to complete reduction. In 14 operative cases, intussusception had been reduced to the cecum and in one it lay above the cecum in the ascending colon. Only one was resected, sections showed edematous bowel, contused but viable There were only three recurrences and they were true one occurred 2 days, one 2½ days, and one a year postoperatively All three were again reduced by barium enema. Average duration of symptoms in the barium enema group before treatment was 21 hours in those requiring auxiliary surgery, it was 27 hours. Hospitalization lasted two days less for the barium enema group

Barium enema hydrostatic pressure reduction with fluoroscopic control is preferable to saline enema. A Foley bag catheter is placed in the rectum without lubricant the balloon is then distended and the buttocks are tightly taped with adhesive Barium is permitted to flow by gravity from 3-3½ ft above the patient. As the barium column with its convex advancing head reaches the intussusception, its leading edge becomes concave and outlines the intussusception projecting into the lumen. With pressure maintained, the horns of the meniscus extend and elongate until suddenly the intussusception gives way At times the process is swift at others stubborn, with a hang at the flexures of the colon Manipulation and external pressure should not be used, but it may become necessary to expel the barium and repeat the enema for complete reduction. Chief factors in success are tight compression of the nates to maintain hydrostatic pressure without release and unimpeded barium flow through the tubing Reduction is confirmed by free filling of the small bowel, disappearance of mass, obvious improvement in the patient's condition and passage of feces or flatus per rectum. Charcoal instilled in the stomach and recovered

(7) Ann. Surg. 135 596-605 May 1952.

by enema six hours later further confirms reduction. If reduction is incomplete and a negative shadow is seen in the cecum, if the ileum does not fill or if the meniscus can be followed into the terminal ileum and the ileum then fills slowly or only partially, the abdomen should be opened promptly

Studies indicate that pressure much greater than that obtained from a height of 3½ ft. is required to rupture the bowel. *Polyps or Meckel's diverticula may* be more easily missed than by opening the abdomen but these lesions are not dangerous in themselves. No child returned for therapy of symptoms resulting from a specific lesion missed at barium enema reduction. If intussusception recurs, operation should follow search for possible focal lesion by hydrostatic pressure reduction As described, hydrostatic reduction is not blind or delaying—the two commonest criticisms of the method. Supportive fluids and other therapy can be given during the procedure

The new fluoroscopic screen intensifier has been used to make roentgen motion pictures of barium enema reductions without more radiation than is used in conventional fluoroscopic technics. This allows demonstration of findings in larger groups with actual gain in definition of the image

Role of Clostridium Welchii in Strangulation Obstruction was investigated experimentally in dogs by Isidore Cohn Jr., and Herbert R. Hawthorne[8] (Univ of Pennsylvania) A loop of bowel was used which had been isolated, devascularized denervated, completely severed and closed Four *experiments were conducted.*

1 A closed, isolated loop of bowel was placed intraperitoneally into six dogs. After operation, they were in good condition until two or three hours before death. At this time vomiting began and blood urea nitrogen and nonprotein nitrogen values increased. Death took place within 30 hours. The peritoneal fluid was pinkish odorless and coagulable in the early stages, but changed later to a malodorous, darker fluid. It contained Cl. welchii, Bacillus coli and streptococci

2 A sterile autoclaved loop of bowel was placed intraperitoneally into eight dogs Three survived, two of which consistently did not show Cl welchii in the peritoneal fluid

(8) Ann. Surg. 134:999 1006 December 1951

One showed the organisms inconstantly In four of the five which died, Cl. welchii was found, in the fifth, staphylo- and streptococcic peritonitis and staphylococcic septicemia were present

3 Sublethal doses of washed Cl. welchii were injected into sterile, autoclaved bowel, which was placed intraperitoneally into five dogs (control injections had no ill effects) The two which survived had received the smaller doses, and Cl. welchii was never recovered from the peritoneal fluid of one This seems to demonstrate the role of Cl. welchii in strangulation obstruction.

4. Fresh, sterile bowel containing sublethal doses of Cl welchii was placed intraperitoneally into seven dogs Sterile, isolated bowel was prepared by allowing both ends of an isolated, well vascularized, 10 cm. loop of bowel to remain open in the peritoneal cavity for a month before it was closed off, severed from its vascular attachments and washed culture injected. Two dogs survived, presumably due to attenuation of the Cl. welchii.

Of five dogs from which Cl welchii was not recovered four survived, one dying of pyogenic peritonitis and septicemia Three dogs with positive peritoneal cultures survived, two with attenuated cultures and one with presumed unusual resistance It was concluded that death in adequately treated experimental strangulation obstruction is due to the exotoxins of Cl. welchii which are produced in the presence of dead or dying tissues

[Clostridium welchii is so much more common in dogs than in humans it is doubtful if these results are applicable to the human.—Ed.]

Critical Evaluation of the Noble Plication Procedure in Management of Chronic Recurrent Intestinal Obstruction Due to Adhesions. Jere W Lord, Jr.,[9] (New York Univ) analyzes results of complete plication of the small intestine in 11 patients with chronic recurrent intestinal obstruction due to adhesions The Noble operation converts adhesions from uncontrolled to controlled so as not to interfere with normal mobility and function of the small intestine Average number of operations for lysis of adhesions before plication was four five narcotic addicts were in the group Ages ranged from 13 to 57 Average postoperative follow up was 24 months, the longest 56 months, the shortest 2 months

(9) Gastroenterology 19:801-811 December 1951

TECHNIC.—A generous right rectus muscle-splitting incision is made because most adhesions are in the right lower quadrant and pelvis. When the abdomen is opened, loops of small bowel may be involved in adhesions with one another, with the mesentery, colon, parietal peritoneum and possibly between the omentum and parietal peritoneum or mesentery. The most common procedure is systematic division of all adhesions from the ileocecal valve and proximally to the ligament of Treitz until no part of the small bowel shows a point of adherence. Beginning at the ileocecal valve, the entire small bowel is then plicated, joining adjacent loops with fine interrupted cotton or silk sutures. The average loop is 6-8 in. long and sutured carefully to the adjacent one to avoid acute kink or angulation.

Six patients became symptom free, resumed normal activities and showed no signs of malnutrition. Two of these were addicted to drugs before the plication but were not after surgery. Two are classified as having good results, one with no objective evidence of intestinal obstruction continued to use demerol® and was hospitalized several times with simulated attacks of intestinal obstruction, unconfirmed by abdominal flat plates or small intestine barium studies; the other had abdominal cramps for one month postoperatively but was entirely well thereafter.

Of three patients classified as failures, one died four months postoperatively of intestinal obstruction and peritonitis. One had persisting symptoms of intestinal obstruction, and one improved slowly with possible good or excellent end results. Analysis of failures showed that in one, a 2 ft. portion of the upper jejunum was overlooked, in another a cotton suture was placed too deeply, and in the third, fine plain catgut with an insufficient holding period (five to six days) was used. Perfection in technic gives uniformly good results.

Radiation Injury to Small Intestine during treatment for carcinoma of the cervix or the uterus has always been a source of concern to the physician. When the small intestine is damaged, the usual complication is intestinal obstruction. Two uncommon complications of massive hemorrhage and perforation of ulcerations in the small intestine are reported by Clarence E. Gardner, Jr., and William G. Anlyan[1] (Duke Univ.)

CASE 1.—Woman, 67, had massive hemorrhages from three ulcerating stenosing lesions in the terminal ileum and one in the rectosigmoid. Intracervical and intravaginal radium therapy and x-ray

(1) Surgery 31:746-749, May 1952.

treatments over sacral and abdominal ports had been given 12½ years before. Because of continuous bleeding from the bowel for two weeks, a 10 cm. segment of terminal ileum containing three bleeding ulcers and an 11 cm. segment of rectosigmoid were resected and primary anastomosis was done at each site. Convalescence was uneventful and there was no further bleeding from the bowel

CASE 2.—Woman, 43, had a walled-off perforation in a necrotic segment of terminal ileum six months after x ray treatment and intracervical and intravaginal radium in the cervical stump At operation an almost complete intestinal obstruction and gross soiling were noted. The necrotic portion of the small intestine was resected and an end to-end anastomosis done. A fecal fistula which developed postoperatively closed spontaneously

Incidence of injury to the small intestine during radiation therapy for carcinoma of the cervix is not high Some observers believe that radium more often causes radiation injury to the bowel than x ray therapy It has also been emphasized that the intestine is more vulnerable to injury after a supravaginal hysterectomy Treatment of the sequelae of radiation ulcerations in the small intestine is essentially the same as treatment of any other ulcerating or obstructing process in the bowel.

Surgical Significance of Small Bowel Tumors E Lee Strohl, Willis G Diffenbaugh and Francis E Sarver[2] (Chicago) report data on 16 tumors of the jejunum and ileum of which 14 were malignant and 2 benign. The latter were a fibroma and a leiomyoma, both in the lower ileum Decided weight loss was the commonest presenting complaint, occurring in 14 cases Recurring episodes of partial intestinal obstruction, at intervals of three to four months were present in 14 and were manifested by pain, abdominal cramps, nausea and vomiting Diarrhea was present in three cases. Intussusception occurred in two

Distention of the abdomen, suggesting partial intestinal obstruction, was noted in 10 cases and acute intestinal obstruction was present in 4. Anemia of severe degree was present in 10 Gross hemorrhage occurred in one case and tarry stools in four A palpable mass was evident in five

Individualized small bowel x ray studies are necessary to establish a diagnosis Dilatation proximal to an area of constriction is a common finding and retention of barium in the small bowel for more than eight hours is suggestive Segmentation of barium occurs frequently

(2) Surg., Gynec. & Obst. 92 260 214 August, 1951

Of the 14 malignant tumors, 6 were carcinomas (3 in the jejunum and 3 in the ileum), and all were associated with metastatic spread Five were sarcomas, all in the ileum, and two produced intra abdominal metastases There were three carcinoid tumors, all in the ileum and all with metastatic spread to the regional lymph nodes.

Exploratory operation was done on nine malignant tumors, and eight were resected Five tumors were found at autopsy Three patients with resection were well, with no evidence of recurrence, after one, three and eight years Three survived surgery but died of recurrence within a few months One patient had a recurrence two years after resection. A second operation was performed, and the patient was alive three years later

Benign Tumors of Small Bowel. John D Olson, Malcolm B Dockerty and Howard K. Gray[3] review 77 such tumors encountered at Mayo Clinic from 1911 to 1942, 38 caused clinical symptoms and 39 were found incidentally There were 10 different types of tumors found in the locations

LOCATION OF BENIGN TUMORS ACCORDING TO DIVISIONS OF SMALL INTESTINE

Type	Duodenum	Jejunum	Ileum	Uncertain	Total
Adenoma total	9	4	8	1	22
Causing symptoms	6	2	3		11
Leiomyoma total	9	10	3		22
Causing symptoms	4	7	3		14
Fibroma total		4	7		11
Causing symptoms		1	3		4
Lipoma total	1	2	4		7
Causing symptoms	1	1	2		4
Pancreatic rests total	5		1		6
Causing symptoms	1				1
Hemangioma total	2	1	1		4
Causing symptoms	2				2
Miscellaneous total		1	3	1	5
Causing symptoms			2		2
Total (all)	26	22	27	2	77
With symptoms	14	11	13		38

indicated in the table Average age was 44.2, and operative mortality, 2.6%

Three types of symptoms were encountered (1) bleeding 42.1% (2) symptoms of obstruction, 36 8%, and (3) symptoms of local bowel irritability 34.2%

Bleeding was most frequent with leiomyoma, occurring

(3) Ann. Surg. 134 195 204 August, 1951

in 78.6% of the 14 symptomatic patients, in the form of hematemesis in 2 and of melena in 9. The bleeding results either from mucous membrane ulceration or from the effect of peristaltic pull on the base of pedunculated lesions. Sometimes hemorrhage is severe enough to necessitate repeated transfusions.

Intestinal obstruction was found in 75% of the 8 fibroma and lipoma patients with symptoms, in 78.6%, intussusception was present or had occurred recently. Pedunculated tumors within the bowel lumen tend to produce intussusception, usually with acute crampy pain below the umbilicus, followed by vomiting. A palpable sausage-shaped mass is often evident, and blood and mucus may be passed in small bowel movements. In one case the pedunculated lipoma could move 15-20 cm. on its pedicle.

Symptoms of local irritability were typical or atypical ulcer pain, indigestion, nausea and/or constipation. Of the 11 adenoma patients with symptoms, 54.5% had evidence of local irritability. Disease of the gallbladder, peptic ulcer, chronic appendicitis, chronic pancreatitis, Meckel's diverticulitis and pelvic disease may be confused with benign tumor because of these symptoms.

Tumor was suspected in 61% of the patients x-rayed. Most of the tumors grew toward the bowel lumen. Only *three of the extraluminal tumors caused symptoms.* The intraluminal lesions are either sessile or polypoid, the latter being more likely to give rise to intussusception through peristaltic pull on the tumor. One pancreatic rest tumor was pedunculated and associated with upper abdominal pain unrelated to eating, belching, indigestion, nausea and vomiting. The other five pancreatic rest tumors were asymptomatic.

Pantothenic Acid in Paralytic Ileus is discussed by J. E. Jacques.[4] Pantothenic acid is one of the vitamin B complex components, d(+) α dihydroxy $\beta\beta$ dimethyl butyryl β-alanine and is present in all body tissues. It is a component of the coenzyme for acetylation, being involved in formation of acetylcholine. This may explain its effect in paralytic ileus.

Although patients with moderate postoperative abdominal distention without fecal vomiting were treated with panto-

(4) Lancet 2: 861-863, Nov. 10, 1951.

thenic acid and fecal vomiting failed to develop, this report is limited to the effects of the drug on 16 postoperative patients with severe ileus and fecal vomiting After onset of ileus, each had undergone at least two ineffective enemas, gastric aspiration and intravenous injection of fluid. Fifty mg calcium pantothenate was given intramuscularly Some patients received only one 50 mg dose, others two or three

Passage of flatus is the most important sign of return of bowel motility, presence or absence of bowel sounds being considered unreliable as a criterion of degree of paralytic ileus All but one patient passed flatus before the second injection (usually within six hours) Sometimes, results were dramatic bowel action following injection within three hours Striking improvement in general condition was evident in all patients. Some had received acetylcholine, pituitary extract, neostigmine and diisopropyl fluorophosphonate without benefit, but all those receiving pantothenic acid made a good recovery

One patient had an old, large incisional hernia in which very active peristalsis was observed half an hour after injection of the drug Within two hours, this patient passed flatus and by the next morning he had spontaneous bowel action.

Postoperative paralytic ileus may represent a low blood pantothenic acid level, which is corrected by intramuscular injection of calcium pantothenate The level can be measured by Pelczar and Porter's method

Small Gut Insufficiency Following Intestinal Surgery II. Massive Resection and Loop Syndrome. W P U Jackson and G C Linder[5] (Univ of Cape Town) report a case that shows the great functional reserve of the small intestine A woman lost two thirds of the small intestine after its intra abdominal herniation behind a previously formed ileosigmoid anastomosis Since the operation she has remained for many years in good physical condition and metabolic tests have shown no gross absorptive defect

A case of the loop syndrome is reported. In this syndrome a by passed loop of small intestine or a blind loop or pouch, in some unknown way produces a deficiency state which may be classed among the "spruelike" conditions. After operation for perforated duodenal ulcer in a man, 30 a

(5) South African J M. Sc. 2 205-224 September 1951

segment of jejunum became attached to the first part of the duodenum and a duodenojejunal fistula developed. This relegated the normal duodenal pathway to the status of an almost nonfunctioning intestinal loop This was demonstrated by a series of x rays with barium and intestinal tubes The patient became severely ill, emaciated edematous and pellagrinous He showed poor intestinal absorption of calcium, phosphorus and fat and good absorption of protein and carbohydrates. There were vitamin C deficiency due to poor absorption and inability to produce water diuresis. Plasma protein and calcium values were low

The loop syndrome may follow any surgical procedure which entails production of a short circuit or blind-ended length of intestine It may follow gastroenterostomy or the Billroth II type of gastrectomy Involvement of the upper end of the small intestine tends to produce steatorrhea particularly involvement of the lower end, anemia Even the most massive intestinal resection does not produce the *full picture of "jejunoileal insufficiency" in that anemia,* hypoproteinemia and edema do not occur and the calcium value is low only rarely The reason for this is unknown, but these cases suggest that amino acids, calcium and hematinic factor may be absorbed in the absence of jejunum and ileum, and that some "toxic" agent other than pure deficiency of jejunoileal absorptive function must be at work in those conditions which produce a 'sprue syndrome."

Appraisal of Long Term Results of Surgical Treatment of Regional Ileitis. John H. Garlock, Burrill B Crohn, Samuel H. Klein and Harry Yarnis[6] (Mount Sinai Hosp, New York City) followed 164 patients for 9-21 years. They previously reported on these patients after a 2 14 year follow up period.

Ileocolostomy with exclusion was performed on 57 patients with no operative mortality Incidence of recurrence was 23 4% in the 47 *patients followed in comparison with* the previous rate of 10 5% Primary resection was done on 45 patients with an operative mortality of 13.3% Previous recurrence rate was 15 4% There have been no recurrences in the "well" patients however only 50% of the survivors were followed There have been four deaths two after operations for intestinal obstruction, one due to intestinal

(6) Gastroenterology 19 414 423 November 1951

tuberculosis and one due to diffuse jejunoileitis. Two stage ileocolic resection was done on 16 patients with two operative deaths Seven patients were well when last seen but recurrence rate was 46% One patient with recurrence died after operation at another hospital in another, universal ulcerative colitis developed which required permanent ileostomy and complete colectomy, one had a second resection in 1946 and has remained well, and the fourth, reported originally as having recurrence on the basis of x rays, remained well without further therapy Previous recurrence rate (up to 1944) was 28 6% Combined ileocolitis is the greatest problem Operative mortality was 17 6% among 19 patients, and only 3 of the 10 patients followed were in good health. Two had recurrences before 1945 Since then, four have had recurrences two died after ileostomy, one after subtotal colectomy and one after operation for intestinal obstruction. The outlook after combined ileocolitis is dismal since the patients are likely to have recurrences and late intestinal obstruction.

The longest time interval between operation and recurrence was 14 years. The best and most lasting results follow surgery The lowest recurrence rate was among patients with long-standing ileitis in whom the disease had resolved itself into a sclerotic sharply localized segment of intestine with few if any skip areas In these patients it appears that the virulence of the disease had spent itself, with change from succulent mucosal inflammation and large lymph nodes to the chronic firm, grayish red, obstructed loop of intestine so characteristic of the chronic case In six patients the short segment of recurrent disease proximal to the anastomosis (demonstrated by x ray) later healed completely with abatement of diarrhea

The authors operation of choice continues to be ileotransverse colostomy with exclusion but in recent years they have become more circumspect in selecting patients for operation Mere x ray evidence of narrowing of the terminal ileum with diarrhea, is not an indication. Only when the chronic stage with clearcut x ray changes, is reached should surgery be considered. At operation, careful search should be made for proximal mucosal skip areas. Because they are not easily discerned on the serosal surface, the ileum should be transected at least 2 ft. proximal to

the segment that is obviously involved by the skip areas.

More recently, after extensive resections for jejunoileitis, patients have shown rapid recovery, weight gain and minimal bowel disturbances, despite previous misgivings with regard to nutritional disorders. In one patient only 3½ ft. normal jejunum remains, yet there has been a 30 lb weight gain and diarrhea is minimal. A trend toward more extensive small bowel resection in surgical therapy of ileitis is anticipated

Persistent or Recurrent Proximal Ileitis Following Surgery Ralph Colp and David A Dreiling[7] (Mount Sinai Hosp, New York City) have found that persistence, progression or recurrence of disease after surgery for nonspecific granulomatous ileitis is 28 9% for simple exclusion and 21 8% for resection The patient's fate apparently depends on whether or not disease is definitely localized and remains localized in a comparatively small area of bowel, especially the terminal ileum. Unrecognized areas where incipient mucosal or submucosal lesions are so small as to defy manual or visual detection are the usual bases for further extension or progression of disease in the proximal ileum. When the disease becomes clinically apparent many years after primary operation the unknown agent which originally caused the disease may again have become activated. Presence of active or dormant lesion in an excluded distal ileum ordinarily plays no role in this type of recurrence however, disease sometimes does persist in an excluded ileum.

Ordinarily the problem in recurrent ileitis is its treatment in the proximal small bowel and only rarely in the excluded ileum. If x rays show recurrence through diffuse involvement of the small bowel, it can be treated medically unless obstruction or perforation supervenes Perhaps vagisection will ultimately benefit these unfortunate patients. If however the recurrence is localized in the terminal ileum, further surgical intervention is necessary

Ten cases are reported of treatment of localized recurrent terminal ileitis by division of the ileum with restoration of intestinal continuity by ileosigmoidostomy Ileotransverse colostomy with ileal exclusion is the best treatment for primary ileitis If extension or recurrence develops in the ileum

(7) A.M.A. Arch. Surg 64 28-46 January 1952

proximal to anastomosis to the colon, the disease can again be excluded, without disturbing the ileotransverse colostomy, by a second ileal division with ileosigmoidostomy. Recurrent symptoms, similar to those of primary ileitis, consist of fever and abdominal cramps, loose and frequent stools intermittent intestinal obstruction with distention, nausea and vomiting, loss of weight and anemia X ray studies show bowel narrowing proximal to the anastomosis, often so pronounced that a characteristic string sign is produced.

Preoperative treatment includes a high protein diet, vitamins reinforced by dextrose, saline, whole blood, plasma and hydrolysate, sulfonamide therapy, and use of a Miller Abbott tube At surgery the area of recurrent ileitis is not resected A second ileal division is performed approximately 60 cm. proximal to the last visible evidence of disease and as ileosigmoidostomy is constructed Enough small intestine must be left to insure adequate nutrition. That implantation of the proximal ileum into the sigmoid might lead to serious and persistent diarrhea is entirely unsubstantiated. Contents of the small bowel on entering the colon pass retrogradely for a distance long enough to permit water absorption. That the blind ascending and proximal parts of the transverse colon might become distended and filled with scybala has never been observed.

Postoperative follow up has shown fairly satisfactory results. Some patients during periods of emotional upset, have had frequent but not distressing bowel movements. Disease in the defunctionalized bowel regresses about as much as in primary exclusion. Three patients have been symptom free for 10 12 and 14 years Of the 10 patients 1 died of intestinal obstruction 2½ years after clinical cure by secondary exclusion Among the others so treated, only one (11.1%) had tertiary recurrence whereas seven regained health and were restored to active life

VERMIFORM APPENDIX

Acute Appendicitis in Infants Fifteen Year Study Clifford D Benson, John J Coury Jr., and Donald R. Hagge[8] (Detroit) review experience with 39 infants 24 months or younger All diagnoses were confirmed histologically or if appendix was not removed, by unquestionable clinical picture Only three patients were under 12 months. Incidence of appendicitis increased gradually in the second year and was greatest in the 21st and 22d months of life, 69% of patients were boys four were Negro Patients of both races treated in surgical wards were equally distributed That 28 cases occurred in winter and spring may indicate higher incidence when upper respiratory diseases are most prevalent

Vomiting and fever often preceded onset of obvious abdominal discomfort. Abdominal pain may have ushered in the symptoms, but parents often failed to recognize it until the infant became irritable and flexed his thighs on the abdomen. Most reliable in the history was the report of persistent abdominal pain or discomfort for 8-12 hours without apparent relief diarrhea in seven infants with appendical peritonitis further confused the clinical picture Examinations repeated at short intervals are necessary for diagnosis. Any infant with acute appendicitis suspected although abdominal findings are indefinite, must be rectally examined to elicit local tenderness or pelvic mass Duration of symptoms before hospitalization varied. One infant was hospitalized six hours after symptom onset three not until after 14 days of illness Average rectal temperature in acute nonperforated appendicitis was 100 9 F (range 99 6 102 4 F), in acute perforated appendicitis it was 102.8 F (99.2 105 F) Leukocyte count is not too reliable for diagnosis but forms a valuable part of the whole picture Average leukocyte count in acute appendicitis was 12,286 (7 300 18,200) in appendicitis with perforation and peritonitis it was 17 584 (5 700-38 600) Infants with rectal temperatures of 104 F or more and longer illness at hospitalization had no more than 14 500 leukocytes.

(8) A.M.A. Arch Surg 64 561 570 May 1952

Cases were classified as acute appendicitis (17 9%), perforated appendicitis with peritonitis (33 3%) and appendicitis with mass (48 7%) Once acute appendicitis is definitely diagnosed, prompt appendectomy is indicated. Infants with perforated appendix with peritonitis, with nonlocalization or mass, should have surgery promptly after dehydration and ketosis can be corrected with proper intravenous fluid therapy, suction for decompression and immediate chemotherapy This preparation may take hours Appendectomy with thorough aspiration of abdominal fluid is essential. Intraperitoneal drainage is becoming less common.

Therapy for patients with signs of appendical perforation and mass in right lower quadrant or pelvis is controversial. In the infant, mass may result from agglutination of small bowel loops or cecum to parietal peritoneum the appendical abscess may be small. Furthermore, the underdeveloped omentum offers no protection. If temperature, pulse and mass decreased gradually in 24-72 hours under fluid replacement, nasogastric suction and chemotherapy, the patient was treated expectantly Of 19 patients with perforated appendixes and mass in right lower quadrant or pelvis, 5 had conservative therapy, with one death, the others had the following surgical procedures one appendectomy with no intraperitoneal drainage, 5 appendectomies with intraperitoneal drainage, and 8 surgical drainage of "walled off" appendical abscess, 5 of whom returned for interval appendectomy

Acute Appendicitis in Obstetric Patient. According to H. D Priddle and H. Close Hesseltine,[9] the physical findings and history in acute appendicitis during pregnancy may be almost nil, especially after the first trimester As pregnancy progresses the appendix gradually rises toward the right upper quadrant. Differential diagnosis of pyelitis and appendicitis may be difficult Since leukocytosis may be present in pregnancy this finding is of little value in the diagnosis of appendicitis Progression of gestation leads to protrusion of the abdominal wall, with loss of tone in the rectus muscles. Thus spasm and rigidity of the abdominal wall are less likely to be found.

Since 1931, 41 patients at Chicago Lying in Hospital have undergone surgery for acute appendicitis, an incidence of

(9) Am. J Obst. & Gynec. 62 150-155 July 1951

0 069% in 59,403 deliveries All but six were under age 30 The typical history of acute appendicitis was missing in many instances, since nausea and vomiting are frequent in the first trimester and often are thought to be related only to gestation. The location of pain, however, was typically right lower quadrant in 65% There were muscle spasm in 30%, rebound tenderness in 33% and bilateral lower quadrant tenderness in 6%

The correct diagnosis was made in 28 cases, the original, but erroneous, diagnosis was pyelitis in 4, ectopic pregnancy in 2, twisted ovarian cyst in 3 and gastroenteritis in 1. In three cases the diagnosis was unknown. The primary diagnosis compared well with the pathologic in 26 cases.

The normal physiologic leukocytosis necessitates using only a rising leukocyte count as a diagnostic sign In 27% of cases the count was between 8,700 and 12,500 Admission temperature was less than 100 4 F in 32 cases, in only 2 was it 102.2 F or above

When there is any doubt as to diagnosis, laparotomy is done no matter what the duration of gestation. By contrast, it is a policy not to perform elective appendectomy during pregnancy for so-called chronic appendicitis. Surgery carries minimal hazards of premature labor or abortion. Appendectomy was performed in 39 cases, in 1 of which the appendix had ruptured, probably during labor Drainage of appendical abscess was done in the other two McBurney's incision, with or without Weir's modification, was used. If labor should ensue before complete healing, herniation or evisceration is less likely with this incision. In two cases premature labor ensued, in one in the early part of the last trimester and in the other in the latter part of the second Both infants died These were the only fetal losses. There was one maternal death in 1931 due to a retroperitoneal abscess

Acute appendicitis occurred in about equal numbers in each trimester

Acute Appendicitis in Chronically Ill Geriatric Patients. Although acute appendicitis is uncommon among the elderly it presents difficult problems when it occurs Louis Carp and Joseph A. Arminio[1] (New York City) discuss 21 chronically ill substandard risk patients between 60 and 90 with

(1) Am. J Surg 83 773 780 June, 1952.

acute appendicitis, with or without abscess or peritonitis Differential diagnosis in such patients is difficult because of increased frequency of other abdominal diseases. Underlying degenerative disease of many types also adds to the confusion. In elderly patients, the pain sense may be dulled and the sensorium clouded they are unwilling to seek medical attention early Findings are often atypical Onset is not acute but somewhat insidious. Constitutional disturbance is not severe Three signs are almost constant, tenderness over McBurney's point, rebound tenderness and severe abdominal distention.

Microscopic study of the appendixes suggests that the early massive gangrene observed may result from diminution or absence of lymphoid follicles in the wall of the appendix, sclerosis of vessels supplying it, obstruction in its lumen and previous damage by inflammation. Mortality rate was 23 8% Of 11 patients with acute appendicitis but no perforation all survived appendectomy Conservative therapy without appendectomy or drainage of abscesses or peritonitis is not recommended. Appendectomy is indicated except when technical difficulties would so prolong operative time as to increase mortality, or morbidity would be increased by spread of infection. Antibiotic therapy is supplemental rather than substitutional. A McBurney incision is preferable except when diagnosis is doubtful, necessitating exploratory celiotomy Several autopsies have shown peritonitis pneumonia, cardiac failure and thrombosis as leading causes of death.

Tuberculous Appendicitis Frederick A. Jaffé[2] (McGill Univ) presents a clinicopathologic study of 17 cases from a large general hospital over a 24 year period. The patients were aged 19-52, and 9 were females None of the signs and symptoms were characteristic of tuberculous involvement of the appendix as distinct from acute or chronic nontuberculous appendicitis There were four clinical groups. One consisted of three patients who had a history of transient attacks of slight or moderate pain, usually poorly localized in the lower portion of the abdomen, for six months to one year and had never had an acute abdominal condition. The second group of 10 patients had similar complaints but had recently had attacks of pain of greater

(2) Am. Rev Tuberc. 64 182 191 August, 1951.

severity, localized in the right lower quadrant and accompanied by vomiting The third group of two patients had severe pain of acute onset in the right lower quadrant. The fourth group of two patients had gynecologic complaints and tuberculous salpingitis and endometritis as well as tuberculous appendicitis All patients with acute symptoms showed evidence of nonspecific inflammatory changes in the appendix, either superimposed on tuberculous ulceration of the mucosa or occurring independently The clinical signs in all cases were regarded as entirely nonspecific

All but one patient had concurrent tuberculosis. There were 12 with a pulmonary focus only, 2 with pulmonary and gastrointestinal foci, and 2 with foci in the fallopian tubes and endometrium.

Five specimens were grossly normal and 10 had the appearance of nontuberculous appendicitis, in 2, tubercles and caseation necrosis were seen, suggesting tuberculosis. All the appendixes showed discrete or confluent tubercles in their walls. The central half of the submucosa was the most constantly and most severely affected portion. In five cases the submucosa contained a large abscess which encroached on the muscle layers, and in four of these the abscess cavity was found to communicate with the lumen of the appendix. The nature of these abscesses suggested that they had arisen by extension of submucosal lesions to the mucosa with eventual ulceration into the lumen and consequent secondary infection.

It seems likely that tubercles predispose the appendix to secondary infection owing to their tendency to produce ulceration of the mucosa. Tuberculous appendicitis per se gives rise only to mild symptoms which may be present intermittently for long periods. The appearance of acute symptoms is to be attributed to superimposed purulent inflammation of a nontuberculous nature The appendix is probably more susceptible to tuberculosis than the other portions of the intestine

Involvement of the central part of the submucosa suggests that this layer of the appendix wall is either the first to be involved or that it offers the most favorable environment for development of the lesions. The frequent location of the tubercles along the fascial planes of the muscularis and their congregation in the root of the mesoappendix,

often in relation to veins, indicate a distribution along the vascular tree Although the mucosa cannot be excluded as a possible portal of entry, the miliary nature of the involvement suggests that hematogenous or lymphatic spread occurs in most cases.

Appendicitis and Cancer are associated as a diagnostic and therapeutic problem more often than was previously noted. Cyril Costello and John Saxton[3] (Washington Univ) point out that cancer whether primary or secondary in the appendix may produce acute appendicitis by obstructing the lumen obstructing lymphatic or blood vessels or both, or by infiltrating the wall. In such cases the malignancy may not be recognized. Moreover there is an even larger group of cases in which primary carcinoma of the cecum produces symptoms and signs clinically indistinguishable from those of acute appendicitis. Thus there may be primary carcinoma of the appendix producing acute appendicitis, metastatic carcinoma from a distant organ producing acute ppendicitis, primary carcinoma of the cecum producing acute appendicitis or primary carcinoma of the cecum producing clinical signs simulating those of acute appendicitis Since obstruction of the lumen is the causative factor in If the cases of acute appendicitis, it is not surprising that appendicitis develops in the presence of cancer Obviously the malignancy should be recognized so that it can be dealt with adequately viz., by right colectomy with ileotransverse colostomy

Greater however is the failure to recognize primary cancer of the cecum Such an error may result from failure to inspect the cecum or to take a biopsy specimen at appendectomy to have the appendix examined microscopically at different levels (particularly at the base) or to follow adequately patients treated nonsurgically for appendicitis Of 122 cases of cecal cancer acute appendicitis was the original diagnosis in 25% In 13% of the patients, treatment of appendicitis (usually appendectomy) was carried out without suspicion of carcinoma delaying its diagnosis 1-36 months in relatively young persons. Since many of these lesions at the initial illness are resectable and curable it is mandatory that the possibility of a dual lesion be kept in mind.

(3) Postgrad. Med. 9 482-486 June 1951

Carcinoid Tumors of Appendix. Gerald N Weiss and Ambrose J Hertzog[4] (Tulane Univ) state that carcinoid tumors are the most common neoplasm of the appendix. In 13,374 consecutive appendectomies at the Touro Infirmary 26 carcinoids (0.2%) were found Of the 26 patients 52% were aged 20-30, 85% were females. *According to the literature 1 in every 500 appendectomies will reveal a carcinoid.* In most cases reported the tumor was found only on microscopic examination, incidence depends on the thoroughness of the examination. It is important to do longitudinal sections of the tip of the appendix

A gross "drumstick" appearance is produced at the tip of the appendix, the common site of the lesion. The cut surface has a yellow color and a rubbery consistency The lumen of the distal end of the appendix is usually obliterated by fibrosis Occasionally the growth is of multicentric origin and can only be *recognized by sections through various* levels of the appendix. There was invasion of the muscular wall and serosa in 40% There was no evidence of any lymph node metastasis or extension beyond the appendix *Masson believes that carcinoids result from autonomous* proliferation of argentaffin cells associated with obliterated appendixes containing neuromas. In 77% of the cases there was partial fibrous obliteration of the lumen of the appendix and in 33% neuromas were observed microscopically within the fibrous tissue

Preoperative diagnosis was acute appendicitis in 12 cases, and in the other 14 appendixes were removed incidentally during a laparotomy Most cases were not associated with acute obstructive appendicitis, there was acute focal or suppurative appendicitis in only five

Most carcinoid tumors of the appendix are clinically benign. Prognosis is excellent if simple appendectomy is done, including complete removal of the mesoappendix. None of the patients showed any evidence of spread beyond the appendix and there were no deaths after operation

Carcinoma of Vermiform Appendix. To obtain criteria for management of primary adenocarcinoma exclusive of carcinoid, John R. Hilsabeck Edward S Judd, Jr., and Lewis B Woolner[5] *reviewed 49 cases seen at Mayo Clinic 1910-49*

(4) Surgery 30 657-660 October 1951
(5) S. Clin. North America 31:995 1011 August, 1951.

They classify all cases in three categories carcinoid, malignant mucocele, and carcinoma of the colonic type. Carcinoid is successfully treated by appendectomy in over 99 per cent of cases and so is not considered

Malignant mucocele, found in 29 cases, is characterized by a dilated appendix containing a gelatinous, mucoid material The main danger is rupture, followed by implantation, and by possible production of pseudomyxoma peritonaei Spread is seldom by the blood or lymph stream and rarely by direct extension to the cecum or ileum. Other workers have reported intracapsular metastasis in the ovary to which they applied the term Krukenberg tumor Although the authors found preceding subsequent or accompanying pseudomucinous cystadenocarcinoma of the ovary, since the appendical and ovarian lesions were intracapsular and often one was benign while the other was malignant, they believe that simultaneous and independent, not metastatic, lesions were present.

Appendectomy in most cases of malignant mucocele is curative Right hemicolectomy was performed when a cecal lesion coexisted the nature of which was not clear grossly or the dissection of which might cause spread if malignant. This was particularly true when the tumor had perforated and caused a mass of adhesions and pseudomyxomatous material, dissection of which would be attended by greater risk than hemicolectomy Also a cecal lesion if present, is likely to be a more serious type of carcinoma When pseudomyxoma peritonaei is present, as much of the material as possible is scooped out. The value of postoperative x ray therapy is a moot point.

The colonic type of appendical carcinoma, seen in 12 cases is more malignant than the malignant mucocele and spreads by direct extension to the contiguous cecum, by lymphatic embolization and by the blood stream. This tumor does not produce large quantities of mucus It was confined to the appendical mucosa in all but one case in which the cecum was not involved. Actually in 9 of the 12 cases the lesion was unequivocally primary in the appendix. Lesions confined to the mucosa are comparable to the carcinoma in situ of the cervix and are eradicated by appendectomy When the cecum or terminal ileum is involved, the right portion of the colon and terminal ileum are to be removed.

For lesions not limited to the mucosa of the appendix, right hemicolectomy should be done until more cases are available for analysis.

Among appendical lesions, the prognosis is the poorest for primary adenocarcinoma of the appendix that has spread to involve the cecum. Prognosis following appendectomy for adenomatous polyps in the appendix presenting malignant change is excellent as long as the lesion is strictly confined to the mucosa

Aureomycin in Treatment of Ruptured Appendixes in Children is discussed by Blackburn S Joslin and Miles E. Drake[6] (Univ of Maryland) The small lumen and thin wall of the appendix in children, together with the underdeveloped omentum, predispose them to more serious complications than adults Sixteen children, aged 17 months to 12 years, were treated. They had ruptured appendix with either localized abscess or diffuse peritonitis Twelve were started on aureomycin immediately after surgery and 4 were given the agent prophylactically before operation.

METHOD.—Patients under 5 were given 500 mg aureomycin initially and then 250 mg every four hours until clinical response was obtained, after which 250 mg was given every six hours until the temperature was normal or the patient appeared clinically well for five days. Older children were given the same dosage except that 1 Gm. was given initially Nausea was alleviated by changing to a six hour schedule and giving the drug in sirup or rectally (in mineral oil) The drug was not given parenterally If Wangensteen suction was used, aureomycin was given through the tube and suction stopped for an hour Usually Wangensteen suction was used until peristalsis was established. All patients received fluids parenterally to provide adequate water and salt, 3 Gm. protein/kg body weight, vitamins and carbohydrate sufficient to make up maintenance calories.

All but 4 of the 16 children responded favorably in 24-48 hours The four had a temperature fall by lysis because of periappendical abscess formation. In one patient the abscess was drained immediately and the fibrosed appendix removed three months later Four patients underwent delayed surgery within three months of the acute phase and a fibrosed appendix or abscess sac was removed. Questionable diagnosis and delay in diagnosis were the reasons for postponement of operation Aureomycin caused gradual diminution in size of the abscesses. Five patients were under 4 this is

(6) Pediatrics 7 684-690 May 1951

explained by the increased severity of infection and difficulty in diagnosis in this age group, but all responded well to aureomycin. One patient, with pneumonia as a complication, showed no improvement on a nine day penicillin sulfadiazine regimen, but rapid fall in temperature in 26 hours with clinical improvement after aureomycin treatment (the former had been stopped) Rapidity of response to aureomycin and type of bacteria cultured could not be correlated.

There were no deaths but this is of limited significance because of the small number of cases Although it is too early to draw definite conclusions regarding the efficacy of aureomycin, it apparently is superior to the antibiotics previously used in treatment of ruptured appendix.

COLON AND RECTUM

Diverticulitis of Colon and Its Surgical Management. J Walter Neal, Jr [7] (Raleigh N C) states that diverticulitis of the colon is probably due to inherent weakness of the muscular wall coupled with increased intracolonic pressure resulting from constitutional or environmental causes. The diverticula are acquired or false with walls consisting of mucosa, submucosa and serosa Diameter ranges fom 1 mm. to 2 cm and, with infection, may be much larger The condition in which uninflamed sacs occur is called diverticulosis when inflamed it is called diverticulitis. The small neck opening into the bowel lumen may serve as a mechanical barrier to expulsion of fecal contents which enter the sac. Liquid or semiliquid feces entering the sac may become inspissated and forming a fecalith which damages the mucosal lining of the sac wall and provides a portal of entry for infection. The ensuing edema may impair blood supply, causing gangrene of the sac wall. The inflammatory process may extend to the surrounding bowel wall, muscularis or adjacent organs Histologically the inflamed diverticulum has leukocytic infiltration of the walls and atrophic mucosal changes with thickened opacity of the serosa.

It is estimated that 5% of patients over 40 have diverticu

(7) Surgery 30:606-620 October 1951

losis and that 15-20% of these will have diverticulitis. About 20% with diverticulitis will have complications requiring surgery

Symptoms are variable, depending on location of the disease and degree and extent of the inflammatory process. There may be "left-sided appendicitis" with pain in the left lower quadrant, nausea, vomiting, flatulence, slight distention, tenderness, muscle guarding or slight rigidity, a palpable mass in the left lower quadrant, leukocytosis and low grade fever This classic chain of symptoms is not ordinarily present There may be signs of acute rupture of the diverticulum. Most frequent are those symptoms of chronic diverticulitis which develop slowly over several days or weeks. Intermittent colicky pain constipation and abdominal distention may gradually become worse and lead to partial or total large bowel obstruction with all the accompanying signs Rectal bleeding is seen in 5-22% Cecal diverticulitis may simulate acute appendicitis

Diagnosis depends on x ray demonstration of the diverticula Carcinoma, acute appendicitis, pelvic inflammatory disease and ulcerative colitis must be differentiated.

About 15% of patients require surgery, for which there are six general indications. (1) Acute perforation, the rarest and most serious of all complications, requires incision and drainage No attempt should be made to close the perforation for sutures will not ordinarily hold in the inflamed and edematous bowel wall (2) Localized abscess, the most frequent complication, is caused by a slow leak that forms a localized walled-off peridiverticular abscess, usually in the left lower quadrant. Some abscesses will disappear with antibiotics. Others will drain into the rectum or into the bladder and form a fistula or break through the abdominal wall or perineal floor and form a fistula Incision and drainage, extraperitoneal when there are pain and fever is the treatment of choice (3) Most partial and many complete obstructions subside under conservative treatment of rest, intestinal intubation and suction, but if medication is unsuccessful a transverse colostomy should be done After 24-48 hours it is safe to open wide the exteriorized loop It is wise to wait a year before closing the colostomy With evidence of narrowing of the lumen and with the involved segment less than 15 20 cm., it is best to resect the

segment with an end to-end anastomosis, closing the colostomy after about six weeks (4) Many abdominal fistulas close under conservative treatment, but if medication does not help, colostomy should be done After the fecal current has been diverted and the distal loop prepared, the tract and involved segment of colon should be resected with an end to-end anastomosis and the colostomy closed in six weeks. Rectocolic fistulas require no surgery as they all heal spontaneously Colostomy and resection of the involved bowel and fistula are necessary for sigmoidovesical fistula (5) If there is any doubt as to possible malignancy, radical resection of the bowel segment should be done

Acute Diverticulitis of Cecum Report of 4 Cases and Review of 153 Surgical Cases James Lauridsen and Frederick P Ross[8] (V.A. Hosp, West Roxbury Mass.) report 4 cases of inflammation of a single diverticulum of the cecum and discuss 149 cases from the literature Preoperative symptoms signs and physical findings are the same as in appendicitis Male preponderance was 84 64, average age was 40 6 and median age 39 Of the 14 8% who did not have a diagnosis of appendicitis, most had had appendectomy Diagnosis at operation was sometimes difficult because inflammatory reaction simulated malignancy Preoperative diagnosis was correct in only 66.9%

Local excision, the operation of choice was done in 43.8% of the 153 cases 57 had colon resection 10 had inversion, 8, drainage, 5 exteriorization and 6 had other procedures. Over all mortality was 4 8% Incorrect diagnosis of malignant disease led to unnecessarily radical surgery and resulted in more than double the mortality of patients treated more simply Mortality for local excisions was 1.6% as against 7.8% in those with colon resection. In 39 cases incorrectly diagnosed as malignant disease at operation, 35 colon operations were performed, with 11.4% mortality In 89 cases correctly diagnosed at surgery mortality rate was 2.2%

Site of lesion was preponderantly (78.8%) at ileocecal valve level or immediately above or below it Six had more than one diverticulum. Average diverticulum had an 0 9 cm. orifice and 2.7 cm. greatest circumference. Of those in which histologic findings were reported, 71.9% were examples of

(8) A.M.A. Arch. Surg. 64:320-330 March, 1952.

true diverticula containing muscle layers The disease is probably embryologic in origin and unrelated to commoner acquired diverticulosis of colon. To facilitate operative diagnosis, frozen sections and careful palpation of the lesion through the opposite cecal wall should be done Diverticular ostium and fecalith, found in more than half the cases, may be palpated.

Oleogranulomas of Rectum Following Rectal Instillation of Petrolatum or Ointment Containing Petrolatum David A. Sushow[9] (Mt. Zion Hosp , San Francisco) reports on six patients, none of whom had had any injection therapy for internal hemorrhoids or any other rectal disorder, all of whom had oleogranulomas after anorectal surgery, and all of whom had had 1 2 oz. warmed petrolatum or petrolatum based anesthetic ointment instilled into the rectum postoperatively Instillation had been by aseptic glass syringe, with index finger inserted to prevent the point of the syringe from entering any of the surgically produced raw surfaces or wounds

Only one patient had symptoms. These may consist of a feeling of fulness or pressure in the rectum or a sense of incomplete evacuation. Digital examination reveals a nodule or group of nodules, usually in the internal hemorrhoidal region just above the anorectal line The nodules range from pinpoint to walnut size or larger Proctoscopy shows them to be yellowish, usually covered by intact, thin and sometimes adherent mucosa. Microscopically the mucosa is intact but the submucosa contains fibrous tissue with lymphocytes, macrophages and round or oval spaces containing oil, demonstrated with fat stains. Foreign body multinucleated giant cells may be seen.

Instilled oily substance can enter the submucosa either during injection or by wandering into the tissues through the surgically produced wounds The oleogranulomas ordinarily are not palpable as tumors until after 90 days.

Relation of Chronic Ulcerative Colitis to Carcinoma. Albert S Lyons and John H Garlock[1] (Mount Sinai Hosp., New York City) found that 9 of 226 patients with ulcerative colitis treated surgically had carcinoma of the colon and rectum, an incidence of 3 9 per cent. This supports the

(9) Am. J Surg. 83 496-499 April, 1952
(1) Gastroenterology 18 170-178 June 1951.

view that ulcerative colitis is associated with an appreciably increased incidence of carcinoma of the colon and rectum. Long-standing severe ulcerative colitis seemed especially to bear a relation to malignant change Carcinoma developed in 36 per cent of the patients who had had the disorder for over 12 years and in 43 per cent of the 16 in whom the disease had involved the rectum for over 12 years. In most of these patients carcinoma developed at a much earlier age than it does in those with otherwise normal colons, and the neoplasms were usually highly malignant. Eight of the nine patients died within three years of diagnosis of carcinoma In one patient true adenomas developed throughout the previously normal, smooth colon. The authors concluded that it is dangerous to leave rectum or colon involved by ulcerative colitis in situ for a long time, especially if polypoid degeneration of the mucosa has taken place

Recent Advances in Surgical Treatment of Chronic Ulcerative Colitis are outlined by Robert S Corbett[2] (St. Bartholomew's Hosp., London) Each case presents its own problem. Sometimes minor surgery is necessary before major abdominal surgery is undertaken, e.g., for perirectal or pericolic abscesses, with or without fistula formation. Polyposis, stricture hemorrhage perforation or cancer may also complicate the disease Pyoderma of the lower extremities or arthritis call for colectomy after ileostomy has been done Specific forms of ulcerative colitis, e g., amebiasis and the dysenteries, must be excluded. Proctoscopy and sigmoidoscopy are essential in suspected cases. Granular proctitis commonly precedes ulceration, and pseudopolyposis is a later finding On x ray study with a barium enema the left half of the colon appears smooth and narrowed and usually becomes like a pipe stem. In most cases the disease extends in retrograde manner even into the terminal ileum. Lack of haustrations when only the muscularis mucosae is involved without destruction, is not beyond medical cure All patients should first receive medical treatment, which includes high protein diet, blood transfusions, vitamins B and C succinylsulfathiazole orally and by retention enema, and chloramphenicol, 1 Gm three times daily up to two weeks. The patient must be reassured as to recovery

(2) Ann. Roy Coll. Surgeons England 10-21-32 January 1952.

When surgery is required, ileostomy is the operation of choice Corbett prefers the single barrel type, dropping back the blind distal end of ileum, provided there is no colonic stricture Nature heals the defunctioned colon better than any drugs or solutions applied to it. The ileostomy *is placed on the lateral edge of the rectus sheath* on a line between the umbilicus and the anterior superior spine. Excoriation of the skin is avoided by using closed drainage until the wound is healed and then fitting a bag to the opening, with an aluminum zinc paste to protect the skin. Prolapse of the ileum is prevented by fixation of the mesentery to the undersurface of the peritoneum Subtotal (i.e., to within 1 or 2 in. of the rectosigmoid junction) colectomy in one stage is indicated for continued activity of the disease despite ileostomy, persistent, recurrent pericolic suppuration, stricture, extensive hemorrhage, malignant changes, pyoderma, and arthritis. This operation was done on half of Corbett's patients and was followed by recovery in all who had an established ileostomy

Anastomosis between the ileum and the rectosigmoid so as to regain rectal control represents a recent advance in surgery of ulcerative colitis. The cut ends of the ileum and sigmoid are brought to the surface and the proximal ileum approximated to the rectal stump, anastomosis being effected by an enterotome and secondary closure Corbett has done this operation on seven patients with gratifying results and without return of proctitis or development of malignancy thus far

Surgery of Ulcerative Colitis. B N Brooke[3] (Queen Elisabeth Hosp, Birmingham) considers surgery indicated in (1) chronic ulcerative colitis without remission and with progressive physical deterioration despite medical treatment, (2) ulcerative colitis complicated by stricture, fistula or arthritis which is not likely to be cured without surgery, and (3) long-standing cases in which carcinomatous change threatens Contraindications are (1) fulminating, severely toxemic symptoms of sudden onset and (2) involvement of the ileum (as demonstrated by x ray) Ileocolitis may probably represent a different disease from true ulcerative colitis, particularly when accompanied by macrocytic anemia. Ileostomy is done first, and the colonic tube of pus is drained

(3) Ann. Roy Coll Surgeons England 8:440-456 June 1951

with the aid of lavage, when the patient's condition is satisfactory total colectomy, if indicated, is done in one stage, leaving the rectal stump to be removed, if necessary, by perineal excision.

Preparation for ileostomy includes (1) psychologic preparation, (2) administration of 3-6 Gm. sodium chloride by mouth preoperatively (and afterward) to combat the state of collapse which follows rapid salt depletion from ileostomy and (3) administration of phthalylsulfathiazole beginning four days before operation. Antibiotics are reserved for postoperative complications

TECHNICS.—*Ileostomy*—Intravenous thiopental sodium anesthesia supplemented by nitrous oxide and oxygen, is used (Ether is not given because postoperative vomiting will increase salt imbalance.) Both ileal ends are brought out separately, the proximal end through the middle of a right gridiron incision after routine appendectomy and the distal end through a stab incision above it. The proximal stump must have adequate clearance of the anterior superior iliac spine. The distal stoma, while avoiding the waistline, is placed far enough above the proximal stoma so that the bag does not impinge on it. The cut edge of mesentery is sutured to the parietal peritoneum of the anterior abdominal wall between the two incisions. A purse-string suture is then inserted to close the paraileal gutter below the cecum. The abdomen is closed snugly around the ileum, which is held in position with a few light sutures through its wall. The bag is fixed in position when the patient returns to the ward. Intravenous drip is maintained for a few days to control the chlorides, and sodium chloride is continued by mouth. For toxic patients, colonic lavage is started, 1 Gm. streptomycin in 1 pt. saline being run into the distal stoma in 24 hours. A catheter in the rectum facilitates this. Postoperative ileal obstruction may be overcome by passing a tube into the proximal stoma or running small amounts of normal saline into it. Digital dilatation of the proximal stoma is advisable.

Colectomy—Preoperatively antibiotic colonic lavage is again instituted. Colectomy is done through a left paramedian incision in retrograde fashion, a rectal stump being left below the peritoneal floor of the pelvis after the superior hemorrhoidal arteries are divided. Before closure of the abdomen, the edge of the mesentery rendered free by detachment of the distal ileum is reattached across the paraileal gutter to prevent prolapse of the proximal ileal end. Raw areas remaining at the previous colonic sites are left uncovered.

Complications after ileostomy occur most commonly in the anorectal region and include stricture fissure and fistulas. Remote complications include arthritis. Indications for colectomy are (1) development of these complications, (2) acute exacerbations, (3) failure of the patient to return to

full vigor, and/or (4) threat of malignant change in the presence of continued ulceration Colectomy should be delayed for three to six months after ileostomy if possible.

Of 27 patients on whom ileostomy was performed, one died postoperatively Another, who had ileocolitis and macrocytic anemia, died after discharge from the hospital. Colectomy was subsequently done on 11 patients Nine simple ileostomies were done long enough ago to evaluate results. The patients have returned to full work with an average weight gain of over 42 lb

Two deaths occurred after colectomy Causes were (1) hepatorenal failure and (2) subcutaneous wound dehiscence. with a subsequent fistula and rapid salt depletion. Prolapse of the proximal ileal stump occurred in one patient a year after colectomy owing to failure to reattach the free mesenteric edge This complication is not to be treated by simply cutting off excess bowel, since further prolapse follows Excision of the rectum was necessary in four patients, in one because ulceration persisted, in another because of arthritis and in the others because of continued discharge

Pelvic Autonomic Neurectomy for Ulcerative Colitis, according to R. J Schlitt, J J McNally B G P Shafiroff and J W Hinton[4] (University Hosp., New York City), must include removal of both parasympathetic and sympathetic impulses to the colon. They have evolved an operative technic which makes possible bilateral exposure and extirpation of hypogastric nerves and inferior hypogastric or Frankenhauser's ganglions Because the sacral parasympathetic spray of nerves either courses through, or is intimately associated with, the inferior hypogastric ganglions, this procedure effectively interupts all autonomic nerve supply to pelvic viscera with the possible exception of some sympathetic fibers traveling down paravertebral sympathetic chains. The technic interrupts sacral parasympathetic innervation extending up the descending colon and possibly even to the cecum

Eleven patients, 16-56 who had symptoms for 5 months to 10 years, were observed postoperatively for 2½ months to 4 years. With no operative mortality results were excellent in five, good in five and poor in one. The last patient failed later to respond to vagotomy, then ileostomy and died

(4) Gastroenterology 19 812-819 December 1951

4½ months after pelvic neurectomy, autopsy showed advanced ulcerative colitis and acute suppurative peritonitis and pleuritis but no gastrointestinal perforation.

Of four patients with complications, two had mild transient urinary dysfunction which spontaneously disappeared. In one, a woman, moderately severe urinary retention developed; cystometries revealed a hypotonic, neurogenic bladder; transurethral resection of the bladder neck enabled her to void successfully. One man lost the power to ejaculate; potency was not affected.

The stools changed from diarrheal to formed or semiformed. In all instances the number of daily defecations was more than halved; in most patients it was brought to one to three stools every 24 hours. In all cases gross blood disappeared completely. Weight gains ranged from 10 to 40 lb. Proctoscopy revealed either complete or almost complete clearing in all. Roentgenography of the colon remnant failed to show any change.

Congenital Megacolon (Hirschsprung's Disease): Follow-up on 82 Patients Treated Surgically. Orvar Swenson[5] (Boston Floating Hosp.) calls attention to a new concept of the pathologic process of congenital megacolon, i.e., absence of ganglion cells in Auerbach's plexus in the rectosigmoid and rectum. This defect is thought to account for the absence of peristalsis in the distal colon. Tracings of large bowel peristalsis for patients with colostomies demonstrate the lack of peristaltic waves in the rectosigmoid. Resection of the rectum and rectosigmoid with a pull-through anastomosis is the operation of choice.

The disease must be differentiated from chronic constipation and dilatation of the colon due to tumors and strictures of the rectum. Certain diagnosis can be made only when a barium enema study demonstrates the narrow rectosigmoid and the dilated bowel above this area. When dilatation extends down to the anal sphincter and there is good evacuation, a diagnosis of chronic constipation is made. These patients are usually cured with low residue diets and careful habit training. In newborn and young infants diagnosis is difficult because colon dilatation is minimal and the abrupt change in caliber from sigmoid to rectosigmoid is not present. Many newborn infants with congenital mega-

(5) Pediatrics 8:542-547, October, 1951.

colon present a picture of small bowel obstruction with vomiting, abdominal distention and failure to pass meconium

Once the diagnosis is made, patients are prepared for a one stage resection, except extremely ill patients with pronounced abdominal distention, in which case preliminary colostomy is performed. A 30 day preoperative preparation consisting of low residue diet, mineral oil orally and daily enemas is prescribed. Succinylsulfathiazole is given for 14 days A careful examination of the urinary system is made and should include cystograms, cystometrograms, determination of the residual urine and intravenous urograms. More than half the patients have atonic bladders with increased capacity Preoperative rectal irrigations are performed by inserting a large soft rectal tube through the narrow segment into the dilated colon.

Resection of the rectum and rectosigmoid are well tolerated by the patients. The bladder is drained postoperatively by a urethral catheter for four days. Tidal irrigations are utilized for six days. When the cystometrogram is comparable to that made preoperatively, the catheter is removed.

In 82 cases there were only four urinary complications, mild infections postoperatively in 2 and prolonged catheter drainage in 2 Children under age 3 tend to have bouts of diarrhea after operation There was one recurrence In this case, at operation there was no difference in caliber between the normal and the aganglionic bowel. A second operation demonstrated an 8 cm aganglionic segment which was missed at the first procedure

Sphincter function was normal in all patients postoperatively Abdominal distention disappeared over six to eight months All patients gained weight, and general growth has been normal Diets are unrestricted and no mineral oil, laxatives or enemas are necessary Barium enemas as early as the second postoperative month have shown essentially normal colons.

Diffuse Familial Polyposis of Colon is a rare inheritable disease, transmitted by and to both sexes as a mendelian dominant characteristic Manifestations of the disease have not been found in the newborn but do appear early in life Charles W Mayo James H DeWeerd and Raymond J Jack

scarred, contracted, ill functioning channel. An attempt is made to preserve intestinal continuity by ileosigmoidostomy, leaving the distal 20-24 cm. of the colon intact in type 1 cases. In type 2, a multiple stage total colectomy is done with establishment of a permanent ileac stoma.

Subtotal colectomy was done with ileosigmoidal or ileorectosigmoidal anastomosis on 41 patients. Fulguration was carried out first so the anastomosis could be made in a colonic segment free from polyps. End to-end ileosigmoidostomy was preferred because it eliminates the danger of sacculation and dilatation of the blind end of the ileum. Inequalities in size of lumen can be dealt with by cutting the small bowel obliquely and further increasing the circumference of the cut edge by cutting its antimesenteric border longitudinally when necessary Anastomosis should be made at a site that can subsequently be visualized by proctoscopy so that all polyps which subsequently form can be fulgurated. Although subtotal colectomy was done in multiple stages in 31 of the 41 cases, the authors now favor single stage operation with end to-end ileosigmoidostomy

In 17 patients secondary malignant lesions necessitated an alteration of the routine procedure according to individual indications Advanced malignant change in the colon was present in 30 of the 73 patients operated on.

There was a total of nine hospital deaths, seven of which occurred before the advent of antibiotics and present day preparation of the colon. Thirty five of the 41 patients survived operation, 6 for 10 years or more In 3 of the 41 who had ileosigmoidostomy and subtotal colectomy a malignant lesion of the rectum developed later and it was necessary to perform combined abdominoperineal resection with a permanent ileac stoma.

Proctosigmoidoscopic examination every 6-12 months for the remainder of the patient's life is essential if ileosigmoidostomy has been done In this way immediate, combined abdominoperineal resection of the rectum and sigmoid with establishment of a permanent ileac stoma may be done if malignant degeneration occurs

Malignant Polyps of Rectum and Sigmoid Therapy Based on Pathologic Considerations Edwin R. Fisher and Rupert B Turnbull, Jr.,[7] (Cleveland Clinic) followed up 21 patients

(7) Surg Gynec. & Obst. 94:619-626 May 1952

with rectal and lower sigmoidal carcinoma arising in polyps which had originally been treated locally by fulguration and radon implantation and which had been evaluated as clinically benign.

All intestinal polyps are precancerous "Adenomatous" refers to a polyp characterized by mature, mucus-secreting cells of the goblet type forming regular glands resembling those of normal colonic mucosa "Papillomatous" describes a polyp more complex in structure with frondlike projections covered by tall columnar epithelial cells, oftener non secreting in type and forming irregularly shaped glands with frequent involutions Both lesions are neoplastic either type depending on location, may be pedunculated

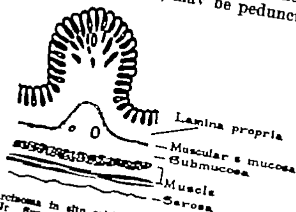


Fig 160 —Carcinoma in situ arising in polyp (Courtesy of Fisher E. R., and Turnbull, R. B Jr Surg. Gynec. & Obst. 94 619-6 5 May 1952)

Grossly a polyp has no definitely consistent features indicative of malignant change Histologic criteria for diagnosis of carcinoma in a polyp consist of (1) anaplasia characterized by variation in size of cells and their nuclei, atypical mitoses and prominent nucleoli, (2) irregularity characterized by true stratification, intraglandular budding and loss of cellular and nuclear polarity, and/or (3) invasion. Malignant change limited to glandular structures of the polyp with no evidence of invasion of the lamina propia is carcinoma in situ (Fig 160) A lesion with invasion of the lamina propria but with no invasion of the muscularis mucosa or lymphatic and vascular channels is termed superficial carcinoma (Fig 161) Invasion of muscularis mucosa and/or lymphatic and vascular spaces is characteristic of invasive carcinoma (Fig 162) Discovery of desmoplastic tumor stroma in invasive carcinomas has been valuable his-

tologically in establishing this degree of malignancy Histologic study cannot predict the outcome of benign lesions.

In this series, incidence of carcinoma arising in polyps was greatest in the 5th and 6th decades These lesions have

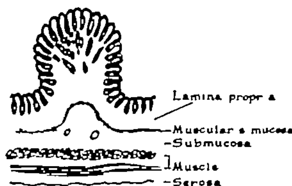


Fig. 161—Superficial carcinoma arising in polyp. (Courtesy of Fisher E. R., and Turnbull, R. B. Jr Surg., Gynec. & Obst. 94 619-626 May 1952.)

no apparent predilection in location in the various quadrants of the rectum or sigmoid. In 14 patients, the lesions were classed as either in situ or superficial carcinoma and in 7 as invasive All patients survived 2-10 years 13 lived 5 years or more Two patients died of carcinomatosis from

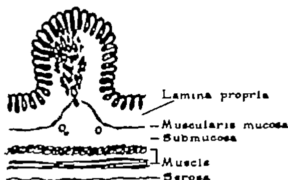


Fig 162.—Invasive carcinoma arising in polyp. (Courtesy of Fisher E. R., and Turnbull, R. B., Jr.: Surg., Gynec. & Obst. 94 619-626 May 1952.)

a second lesion in another portion of the colon, one died of cirrhosis of the liver Five patients had superficial carcinoma with recurrences or incomplete removal. None of the recurrent lesions were malignant. Two patients with superficial carcinoma had abdominoperineal resection four and five years after local therapy because the lesion was uncon

trolled Lesions did not recur in the year after local therapy in any patient of either group Polyps with in situ or superficial carcinoma, if located within 5 in. of the dentate line, can be safely treated by complete local removal and destruction of the base by radon seeds or coagulation Lesions on a long pedicle 5 in. above the dentate line can be removed by colotomy and the chance of encountering carcinoma in such a polyp is rare Patients with diffuse lesions should have abdominoperineal resection or "pull through" surgery All seven patients with invasive carcinoma in polyp were alive and symptom free at follow up Possible late recurrence or metastasis in invasive carcinomas in polyps makes radical surgery mandatory

Application of Cytology in Diagnosis of Cancer of Rectum, Sigmoid and Descending Colon The cytologic method is based on the fact that malignant neoplasms with a free



Fig. 162—Early malignant change in polyp (reduced from × 600) (Courtesy of Bader G. M., and Papanicolaou, G. N.: Cancer 5 307 314 March, 1952.)

surface constantly exfoliate superficially placed cells Available technics have improved collection, preparation and staining of such specimens. Genevieve M. Bader and George N Papanicolaou[3] (Memorial Hosp., New York City) report results of 229 rectal and colon washings in 200 patients Rectal washings were done by proctoscope using a special long syringe. Colon washings were obtained with an enema

(3) Cancer 5.307-314 March, 1952.

of 500-800 cc normal saline All patients were prepared with 2 oz. castor oil given the night before examination, followed by cleansing enemas the morning of examination. An equal part of 95% alcohol was immediately added to the material collected After centrifuging of the specimen, sediment was fixed, specially stained and examined. More than a small amount of fecal material interferes with successful reading of slides.

The first 100 washings were chiefly from normal subjects Normal cytology of both rectal and colon washings is relatively uniform, with little variation in size and form of exfoliated cells. Biopsy and surgery showed cancer in 19 cases smears of 18 had been positive or suspicious and of 1, benign, but later proved to be a malignant polyp No false positives were found Malignant neoplasms can be detected at an early stage by characteristic morphologic changes primarily in the nucleus (Fig 163) The method was especially useful in diagnosing sigmoid lesions beyond reach of the proctoscope and particularly in differentiating between diverticulitis and carcinoma in one case The method is also valuable in detection of rectal and colon polyps when used as an adjunct to proctoscopy and roentgen examination. In 34 cases of proved polyps, 30 (88.2%) showed cell clusters suggestive of polypoid growth in smears. In some instances, the smears were the first indication of polyp confirmed only after repeated, careful roentgen ray examination.

Adenocarcinoma of Large Intestine Associated with Chronic Ulcerative Colitis Wilbourn C Shands, Malcolm B Dockerty and J Arnold Bargen[9] (Mayo Clinic and Found.) report data on 40 patients who were treated surgically and 38 who were considered inoperable Malignancy was proved by biopsy Risk of development of a secondary adenocarcinoma of the large bowel in cases of chronic ulcerative colitis increases with duration of the disease Average age at onset of colitis was 26 7 years. Average duration of symptoms of colitis before diagnosis of adenocarcinoma was 15.3 years and average age of the patients at the time of diagnosis was 42. Only 11% had colitis for less than 5 years and only 24.7% for less than 10

There was a change in symptoms in 64 patients which heralded development of adenocarcinoma. These symptoms,

(9) Surg., Gynec. & Obst. 94 302-310 March 1952.

in order of frequency, were pain, weight loss, increased number of stools, weakness and anemia

The carcinomas are often of high grade malignancy Thirty nine of 88 separate adenocarcinomas were graded 3 or 4 (Broders) Twenty five patients had mucous adenocarcinomas.

Prognosis is grave Only two patients survived five years, and subsequently one of these died of a second adenocarcinoma of the colon. Fifty seven have died of carcinoma of the large bowel, and 15 have been followed less than five years

Adenocarcinoma of multicentric origin was seen in 21 of 40 resected colons There was a 76.2% incidence of pseudo polyposis in the multicentric cases and a 15 8% per cent incidence in the others.

Patients in whom a secondary adenocarcinoma of the colon or rectum has developed should undergo removal of any remaining portion of colon which is the site of ulcerative colitis Colectomy should be done as soon as diagnosis is established.

Carcinoma of Right Colon Bentley P Colcock[1] (Lahey Clinic) studied 242 patients with carcinoma of the cecum, ascending colon and hepatic flexure These lesions tend to metastasize to lymph nodes along the ileocolic artery and comprise about 13% of all carcinomas of colon and rectum Pain in the right side of the abdomen was a complaint in 55 6% 36 7% had some change in bowel habit, 52 patients had constipation, and 10 diarrhea Loss of weight and anemia also were common symptoms Gross blood in stool and palpable mass were sometimes found. This study shows hardly any progress in early diagnosis of carcinoma of the right colon. Earlier and more frequent examination by barium enema is necessary for earlier diagnosis.

On hospitalization, patients are given ½ oz. magnesium sulfate and prepared with 2 Gm. sulfathalidine* four times daily and colonic irrigations twice daily If obstruction is apparent, a Miller Abbott tube is used to decompress the small bowel. Cecostomy is considered for severe dilatation of cecal and ascending colon 48 hours before operation, 1 Gm streptomycin is given daily and 24 hours before the Miller Abbott tube is used to detect possible obstruction General

(1) New England J Med. 246 391 396 Mar 13 1952.

preparation of the patient is important Laparotomy alone was done in 14 patients, 26 had palliative ileotransverse colostomy and 202 had resection. In 202, modified Mikulicz operation was the choice for 142, 54 had one stage resection with primary anastomosis, and 6 had two stage ileotransverse colostomy with subsequent resection of the right colon.

Of 120 patients who had resections over 5 years ago, 52

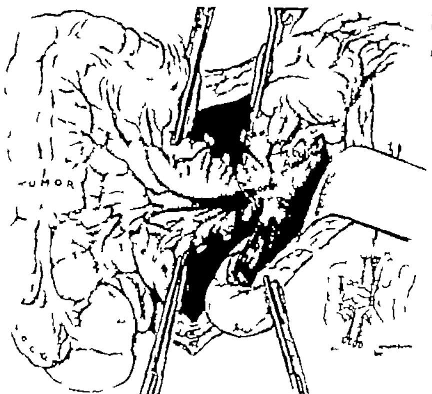


Fig 164 —Extent of resection in one stage colectomy (Courtesy of Colcock B. P: New England J Med. 246 391-396 Mar 13 1952)

were alive and well 5-10 years after surgery, 51 died of recurrent carcinoma 9 died of other causes, and 8 patients were lost to follow up Eliminating as unknowns the patients lost to follow up and those dead of other causes, survival rate among the others was 50 5% Patients with blood vessel invasion by carcinoma had the same survival rate as the group as a whole Those with metastases to the mesenteric lymph nodes had roughly half the survival rate of the entire group Of the 52 who survived five years or more, 25% had local fixation of the growth at time of operation.

Carcinoma of Rectosigmoid and Upper Part of Rectum Recurrence Following Low Anterior Resection. Edward S. Judd, Jr., and Nicholas J Bellegie[2] (Mayo Clinic and Found.) surveyed records of 308 patients who had low anterior resection for malignant lesions 20 cm. or less from the dentate margin of the anus The study period 1936-45 permitted follow up of at least five years "Pull through" operations were not included. Only 26 of the 308 had had palliative resections The recurrence rates are expressed in the table. The highest rate was in low lying lesions In about a third, lesions recurred throughout the pelvis, and

PER CENT RECURRENCE WITHIN FIVE YEARS

YR. AFTER OPERATION	LOCATION OF LESION ABOVE DENTATE LINE		
	10 Cm. or Less (60 Cases)	11-15 Cm. (159 Cases)	16-20 Cm. (61 Cases)
1	18.3	10.7	1.6
2	33.3	22.0	6.6
3	38.3	25.8	13.1
4	40.0	28.3	16.4
5	41.7	30.2	16.4

perhaps even with radical sacrifice of the lower segment of bowel results might not have been better However over 25% of patients had recurrence within the bowel only Lesions which lay well up within the rectosigmoid region showed a surprisingly low incidence of local recurrence Except for lesions 10 cm or less from the anus, results of low anterior resection compared favorably with those of combined abdominoperineal resection.

Of 59 patients with lesions 10 cm. or less above the dentate line, 57.6% lived five or more years after operation, 64.2% of 159 patients with lesion at 11-15 cm. and 73.8% of 61 patients with lesions at 16-20 cm. survived five years High five year survival rate in patients with low lying lesions in which there was such a high recurrence rate was striking

There was some correlation between extent of spread (Dukes classification) and recurrence. Moreover, patients with no recurrence at all had lesions of low grade, and recurrences tended to appear when malignancy was of higher grades. Of those operated on in 1940 or earlier 41% were

(2) A.M.A. Arch. Surg 64 697-706 May 1952.

living and well with no sign of recurrence after more than 10 years. Recurrence, when it appeared, usually did so well within the first five years. Many patients had no demonstrable malignant change (by proctoscopic examination) for at least 18 months after resection, the significant change appearing 18-24 months after operation.

Five patients were alive five years after a second resection. In five cases of recurrence, radium alone yielded surprisingly good prolonged control, one patient was in excellent health 10 years later. However, in 20 others no benefit was demonstrable. In three isolated instances, complete control of local recurrence by radium was demonstrated on repeated biopsies, but the patients died some months later of metastases. *Radium combined with roentgen therapy gave* some degree of control in three cases. In six others, results of roentgen therapy alone were questionable.

All 26 patients who had palliative resections had died. Only one lived until the sixth year. Nine had local recurrences before death, seven others died of metastatic carcinoma.

Carcinoma of Colon and Rectum. Observations on Massachusetts General Hospital Cases, 1937-48. Claude E. Welch and W. Philip Giddings[3] state that it is essential to obtain

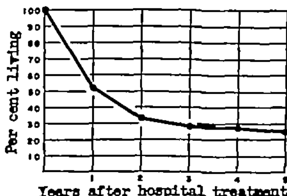


Fig. 165.—Life expectancy, 1,088 cases of carcinoma of colon and rectum at Massachusetts General Hospital, 1937-44. (Courtesy of Welch, C. E. and Giddings, W. P.: New England J. Med. 244:859-867, June 7, 1951.)

some standard method of comparison of treatment results in various centers. Two statistical methods should be used: one, listing results with all patients who are seen with the

(3) New England J. Med. 244:859-867, June 7, 1951.

disease, whether operable or not, the other, including those who were treated surgically with removal of all gross disease and who survived operation. Patients who are lost as well as those who died of intercurrent disease should be counted as dead of cancer.

There were 1,876 cases seen at the Massachusetts General Hospital between 1937 and 1948. Five year survival rate for the 1,088 seen between 1937 and 1944 was 26% (Fig 165). Time between onset of symptoms and hospitalization averaged seven months for all patients. Cancer must be discovered sooner since two thirds of all cancers of the large bowel are located within the range of sigmoidoscopic examination and nearly 50% are within reach of the examining finger.

CARCINOMA OF COLON AND RECTUM—FIVE YEAR SURVIVAL RATES OF RESECTION FOR CURE, 1937-44*

	No Metastasis			Lymph Node Metastasis		
	Cases	5 Yr Survival	%	Cases	5 Yr Survival	%
Right	50	30	60	26	9	35
Transverse	18	6	33	15	4	27
Left	32	16	50	9	3	33
Sigmoid	74	42	57	17	7	41
Rectum, intraperitoneal	46	25	54	27	4	15
Rectum, extraperitoneal	184	104	58	94	22	23
Totals	404	223	55	188	49	26

* Operative deaths, cases with missing pathologic reports and obstructive resections that showed only gangrene on section are excluded.

Operative mortality was 15% in 1937, 9% between 1939 and 1942, and 3% between 1944 and 1948. The distribution of lesions was: right colon 14%, transverse colon 6%, left colon 8%, sigmoid 17%, intraperitoneal rectum 11%, extraperitoneal rectum 43%, and anus 1%.

There was no significant difference between the various locations of carcinoma with regard to five year survivals, except for transverse colon and anus, for which survival was poor (table). Nor was there significant difference in prognosis at the various levels of the extraperitoneal and intraperitoneal rectum.

Over all figures indicate that 77% of the patients who entered the hospital with cancer of the colon and rectum from 1937 to 1948 had resection of the involved bowel. The

resectability has increased from 72% in 1937-44 to 81% in 1944-48 Five year survivals were obtained in only 25% of the total observed from 1937 to 1944. If results are cal culated on the basis of operative survivals with resections for cure, 45% survived the five year period There was a 55% five year survival if the lymph nodes were not involved and only 26% when metastases were present.

Prophylactic colectomy in ulcerative colitis and in mul tiple polyposis is the only known method of control and should be advised more frequently to avoid cancer Polyps of the rectum or low sigmoid may be treated by fulguration through the sigmoidoscope when the pedicle is long and benign If after the polyp has been removed through the sigmoidoscope the pathologist returns a diagnosis of cancer, a radical operation should be performed Resection of a segment of the colon and mesentery is indicated when the polyp is in the sigmoid or higher Early recurrence after local excision is a poor prognostic sign and a radical operation should follow immediately In patients who survive resection of a cancer of the colon, a second carcinoma of the colon is more likely to develop than in normal persons

Complete left colectomy is required if metastatic nodes are encountered during resection for cancer of the sigmoid or left colon Otherwise the inferior mesenteric artery need not be removed. Resections of tumors of the lower sigmoid and intraperitoneal rectum with anastomosis should not be made unless at least 5 cm. of normal bowel and pericolic tissue can be obtained below the tumor Resection and anas tomosis of the extraperitoneal rectum is rarely indicated.

Since two thirds of all patients with cancer of the colon and rectum are incurable when they reach the hospital, fur ther control of the disease will depend on routine procto-sigmoidoscopy as an integral part of the physical examina tion

Intestinal Antisepsis Present Status in Surgical Condi tions is discussed by Edgar J Poth[4] (Univ of Texas) In testinal antiseptics can be divided into bactericidal and bacteriostatic agents. The second group is represented by the sulfonamides, chiefly sulfasuxidine® sulfathalidine® and phthalylsulfacetamide Their action may be selective thus sulfathiazole and sulfadiazine promptly eliminate the shi

(4) West. J Surg. 60 205-210 May 1952

gella group but have no demonstrable action on other organisms normally present in the bowel. Certain organisms, such as alpha Streptococcus fecalis are not inhibited by any sulfonamide

Among the bactericidal agents, streptomycin is rapid in action but resistance soon develops. Bacitracin and chloramphenicol are of little value Aureomycin and terramycin are effective but produce many side reactions, probably

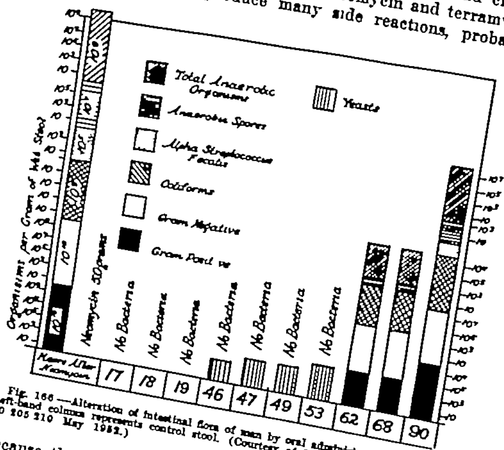


Fig. 166 —Alteration of intestinal flora of man by oral administration of neomycin. Left-hand column represents control stool. (Courtesy of Poth, E. J West. J Surg. 60 205 210 May 1952.)

because they are absorbed from the gastrointestinal tract. Terramycin gives rise to a bloody diarrhea and gastrointestinal ulcers, probably caused by yeast infections.

Neomycin is the most effective antibiotic used (Fig 166) When given orally it is poorly absorbed from the gastrointestinal tract As a result, no toxic reaction followed its administration in some 350 persons sometimes for as long as three months Ordinarily neomycin will eliminate bacteria from the gastrointestinal tract within 24 hours under ideal conditions this was accomplished in 2½ hours In ab-

sence of intestinal obstruction it is possible to prepare the gastrointestinal tract for major surgery in 12 hours. As soon as bacteria have been eliminated, yeasts grow out in large numbers, but no instance of yeast infection or evidence of ulcers has been encountered. Neomycin does not always inhibit Aerobacter aerogenes. This organism can be demonstrated in about 10% of patients treated with this antibiotic in Galveston. When preoperative preparation must be prolonged beyond 24 hours, sulfathalidine* should be combined with neomycin to prevent growth of this organism.

No alteration of clotting, bleeding or prothrombin times under well controlled conditions followed prolonged administration of antiseptic agents.

If it is necessary to operate on the bowel in which the bacterial flora has not been eliminated, the safety of the procedure can be increased by flooding the gastrointestinal tract with a 1% neomycin solution. As much as 1,000 cc of 1% neomycin may be instilled to distribute it throughout the bowel. The solution is injected through the bowel wall using a large needle. Within 45 minutes specimens aspirated from the gastrointestinal tract fail to grow bacteria. No untoward effects were encountered in many such operations. Since a paralytic ileus exists for a considerable time following laparotomy, the antibiotic will be retained in the bowel and provide prolonged local bactericidal effect. One can safely place 1.2 Gm. neomycin in 1% solution into the peritoneal cavity. Larger quantities might prove toxic. Effectiveness of neomycin has been demonstrated in mice which survive intraperitoneal injection of heavy doses of human feces when neomycin is administered intraperitoneally within 30 minutes.

Combined Abdominoperineal Excision of Rectum: Plan for Standardization of Proximal Extent of Dissection. David State[5] (Univ. of Minnesota) describes an operative technic based on the anatomic distribution of lymph nodes that drain the efferent extramural lymphatics of the rectum and on the known pathways of proximal metastatic spread of carcinoma of the rectum.

TECHNIC.—A left hockey stick incision is used, the vertical paramedian component of which begins at the symphysis pubis and extends to just below the umbilicus. The oblique portion extends from

(5) Surgery 30:349-354, August, 1951

this point to the costal margin at about the level of the anterior tip of the ninth rib. The operability of the lesion is determined and the presence or absence of regional lymph node or liver metastasis noted. The inferior mesenteric artery is dissected as it arises from the aorta and is transected between forceps. The posterior parietal peritoneum is incised to the right of the aorta over the inferior vena

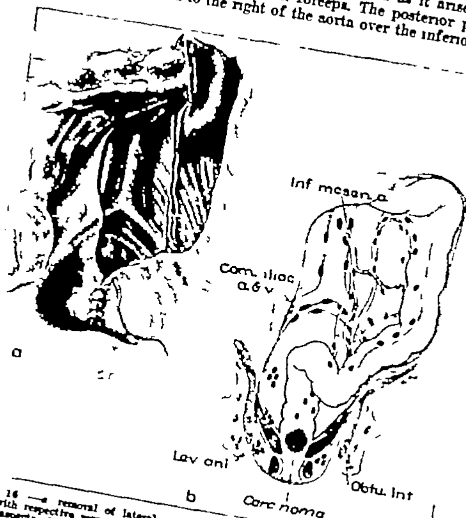


Fig 16 —*a* removal of lateral one fourth of transverse, descending and pelvic colon with respective mesocolons. Clean dissection of lymph nodes from anterior and lateral aspects of aorta and inferior vena cava, from level of duodenum to bifurcation. Removal of lymph nodes from around common iliac arteries. Beginning reconstitution of pelvic floor with interrupted silk sutures. *b* extent of lymph node dissection and removal of colon and mesocolon distal to lateral one fourth of transverse colon. (Courtesy of State, D Surgery 30:349 354 August, 1951)

cava from the level of the third portion of the duodenum down into the true pelvis, where the pelvic mesocolon arises. The parietal peritoneum to the left of the pelvic and descending colon is incised and dissection continued to mobilize the splenic flexure and lateral one fourth of the transverse colon. The latter is transected and the transverse mesocolon incised obliquely and inferiorly to meet the initial incision of the peritoneum at the level of the third portion of the

duodenum The lateral one fourth of the transverse colon, descending colon and pelvic colon with their respective mesenteries and contained lymph nodes are dissected inferiorly (Fig. 167) The lymph nodes of the anterior and lateral aspects of the aorta and inferior vena cava, from the level of the third portion of the duodenum down to the bifurcation of the aorta into the common iliac arteries, are then dissected. *Dissection is carried out in a readily entered plane* between the adventitia of the aorta and the surrounding periadventitial tissues containing, in addition to lymph nodes, the preaortic sympathetic nerve plexuses and loose connective tissue Care is taken to dissect out the lymph nodes along the common iliac vessels. The lymph nodes along the sacrum below the bifurcation of the aorta are taken as the dissection continues into the pelvis.

Mobilization of the rectum, dissection laterally, including the levator ani, and dissection in the perineum inferiorly are done in the standard fashion advocated by Miles. Reconstitution of the pelvic *floor by mobilization of the residual portion of the peritoneum of* the lateral wall of the false pelvis is begun. The transverse colon is brought out as a colostomy The peritoneum and anterior and posterior rectus sheath are sutured to the circumference of the bowel

Physiologic Basis for Preservation of Fecal Continence after Resection of Rectum. Eugene A Gaston[6] (Boston Univ) subdivides fecal continence into reservoir (colonic) continence and sphincteric continence Preservation of reservoir continence requires the retention of some portion of the left colon, which *is basically* a reservoir organ the ileum is often unsatisfactory for this purpose The left colon, like other smooth muscle automatically and without sensation adapts itself, up to a given point, to the bulk of its contents. When this bulk reaches a certain magnitude peristalsis begins and the fecal mass is ejected If a sigmoid colostomy is established on the perineum and encircled by entirely functionless anal sphincters, reservoir continence can be developed by the measures used in abdominal colostomy Sphincteric continence refers to active contraction of the striated muscle of the external anal sphincter, which thereby resists the propulsive force of colonic peristalsis The sphincter therefore mechanically blocks the progress of the fecal mass and, to be effective the force of sphincteric contraction must exceed the propulsive force of colonic peristalsis

The internal anal sphincter consists of a condensation of the circular smooth rectal muscle fibers, is under the control of the *autonomic nervous system, merely takes part* in the peristaltic activity of the rest of the rectal smooth muscle

(6) J A M A 146 1486-1489 Aug 18 1951.

and has nothing to do with sphincteric continence. The external anal sphincter consists of striated muscle, is innervated by somatic nerves and is under voluntary control. Experimental findings indicate that nervous reflexes exist between the rectum and internal sphincter and between the rectum and external sphincter, no such reflex exists between the sigmoid colon and the sphincters. The receptor units initiating these reflexes are sparse per unit area in the upper rectum and become progressively more abundant in the lower rectum. Because the internal sphincter reflex is retained in complete transection of the spinal cord, higher cerebral centers are not necessary to its characteristic relaxation response. The external sphincter reflex is destroyed with transection of the spinal cord and cerebral connections become necessary for it to work.

The reflex arc can be broken by removal of the afferent nerves which originate only in the rectum. With removal of the entire rectum, receptor units of the rectosphincteric reflexes are also removed, destroying the mechanism which warns the external sphincter when and to what extent its services are required. The rectum is therefore as essential to sphincteric continence as the sphincter itself.

Since resection of the entire rectum causes loss of sphincteric continence, at least the distal fourth of the rectum must be preserved for continence. If a patient with a portion of the rectum removed has a sensation in or near the perineum similar to that before an imminent normal bowel movement and if he can voluntarily contract the external sphincter in a normal fashion, both the afferent and efferent portions of the reflex are intact, and true sphincteric continence exists. To preserve sphincteric continence in rectal resections not only the external anal sphincter but also some portion of the immediate superjacent rectum must be retained.

Radical Abdominal Proctosigmoidectomy with Preservation of Anal Sphincter. C. Stuart Welch and Harold F. Rheinlander[7] (Tufts College) describe "pull through" technic for resecting rectosigmoid lesions. It is a good cancer operation which permits complete continence.

TECHNIC.—With the patient in the lithotomy position, with stirrups or conventional knee rests never used, the abdomen is explored

(7) Surg., Gynec. & Obst. 94 550-560 May 1952.

through suprapubic midline incision for metastases and resectability

Then, with the patient in Trendelenburg position, the pelvic peritoneum is incised laterally and anteriorly before mobilizing the rectum. The ureters are identified. The superior hemorrhoidal artery is ligated at its origin and the rectum and rectosigmoid are mobilized posteriorly down to the coccyx in the usual manner The rectum is separated from the hollow of the sacrum and dissected anteriorly from the vagina or prostate and urethra. The lateral rectal stalks with middle hemorrhoidal vessels are divided as far lateral to the

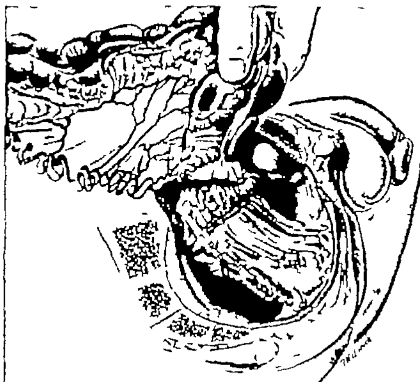


Fig. 168 —Sagittal section showing cancer of rectosigmoid just above pelvic peritoneal reflection and extent of pelvic dissection. Bowel will be divided between the von Petz clips which have been placed 6 cm. below tumor (Courtesy of Welch, C. E., and Rheinlander H. F Surg., Gynec. & Obst. 94 550-560 May 1952)

rectum as possible and the levator ani muscles exposed Unless there is extrarectal extension in the pelvis, the rectum is divided 4-6 cm. below the tumor with von Petz clamps (Fig 168)

The entire left colon is mobilized and its mesentery excised radically The inferior mesenteric artery is severed close to its origin, isolating the mesentery of the sigmoid and descending colon Blood supply to the portion of left colon to be preserved and utilized for anastomosis to the rectum is maintained by the middle colic artery by way of the marginal arteries to the left colon. Lymph-node-bearing tissue around the aorta and inferior vena cava from the common iliac arteries up to the base of the transverse mesocolon is removed.

The left colon is then transected with the von Petz clamp usually in the descending colon or at the junction of the sigmoid and descending colon.

A second surgical team, working in the perineal region, anastomoses the mobilized left colon to the rectal cuff, the second major division of the operation. A long, curved forceps is inserted into the rectal stump through the dilated anal orifice and the closed end of the rectum is grasped and pulled down through the anus to turn it inside out (Fig. 169). The stump is thoroughly cleaned with pHiso-dex and aqueous solution of zephiran.* A transverse incision is made in the everted rectum 3 cm. from the anus and long forceps is passed into the pelvic cavity and the upper colon pulled through the rectal

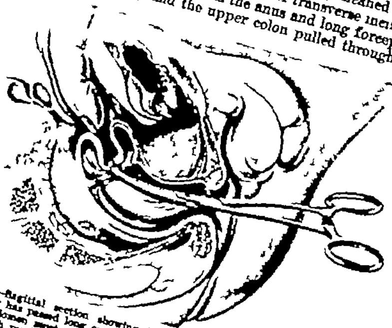


Fig. 169.—Sagittal section showing beginning of perineal phase of operation. Operator below has passed long curved clamp through anus into rectal stump. Surgeon working in abdomen must guide rectum into the instrument. This will avoid tearing the rectum with resulting contamination of pelvic cavity. (Courtesy of Welch, C. E., and Rheinlander, H. F.: Surg., Gynec. & Obst. 94: 650-660, May 1952.)

stump (Fig. 170). A seromuscular layer of interrupted silk sutures is placed and tied to approximate the serosal surface of the proximal colon innermost to the muscularis of the everted rectum with which it is in contact. After this layer is completed the proximal colon is opened transversely 1 cm. distal to the sutures and the excess of proximal colon with the von Petz clips attached trimmed away. Adequacy of blood supply of the proximal colon is tested by observing bleeding. The exposed mucosa is sutured to the everted mucosa of the rectum with a layer of fine interrupted catgut sutures (Fig. 171). When anastomosis is completed the bowel is allowed to retract through the anus. The suture line is then approximately 3 cm. from the mucocutaneous border (Fig. 172). The abdominal surgical team reconstructs the pelvic floor. If necessary a drain is placed through a stab wound in the perineum. Occasionally a proximal colostomy is used for temporary decompression if the suture line is weak.



Fig 172—Sagittal section showing completed operation. Peritoneal floor has been reconstructed. Anastomosis lies just above levatores ani muscles. A drain is placed into the presacral space through a perineal stab wound. *A* line of rectal colonic anastomosis *B* site of reconstruction of pelvic floor (Courtesy of Welch, C. S., and Rheinlander H. F Surg Gynec. & Obst. 94 550 560 May 1952.)

tures, a serious complication, can be avoided by assuring that blood supply to the bowel is adequate that the anastomosis is under no tension and that all sutures are accurately placed

Small Gut Obstructions Following Combined Excision of Rectum Special Reference to Strangulation Round the Colostomy J C Goligher O V Lloyd Davies and C T Robertson[8] (St Mark's Hosp., London) report the occurrence of simple mechanical obstruction of the small gut in 37 of 1 302 patients after combined excision of the rectum. The obstructive lesions were of three types (1) In 15 cases they consisted of adhesions and other lesions not specifically related to the nature of the operation. In 13 of these adhesions had formed between adjacent loops of small gut or between the small gut and the parietes in 1 obstruction was due to a Meckel diverticulum and in 1 to a strangulated hernia

(8) Brit. J Surg. 38:467-473 April, 1951

through the main paramedian wound. (2) In 13 cases obstructions arose in connection with the pelvic peritoneal floor In 10 a loop of small gut became adherent to the suture line in the pelvic peritoneum, in 1 a knuckle of small gut projected in the middle of the suture line through a small opening and in 1 obstruction was due to a severe degree of kinking of the lower ileum, produced by traction on the ileal band during suture of the pelvic peritoneal floor (3) In 10 cases obstructions originated in the vicinity of the

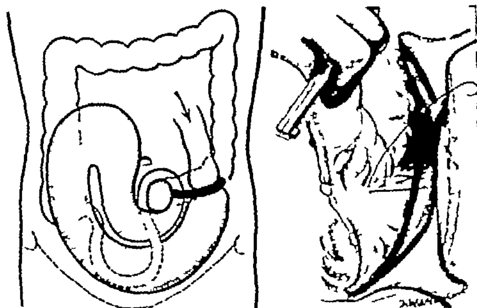


Fig. 173 (left) —Strangulation obstruction of small gut on outer side of colostomy after combined excision of rectum.
Fig. 174 (right) —Technic for closure of lateral space with paramedian colostomy by stitching iliac colon to parietal peritoneum with running suture.
(Courtesy of Goligher J. C., et al. Brit. J Surg. 38:467-472 April, 1951)

colostomy In five of these the small gut became obstructed by adhesions to the peritoneal aspect of the colostomy wound or to the edge of mesocolon stretching forward to the colostomy in one obstruction was due to strangulation of a loop of ileum in a hernia through the colostomy wound, in one to herniation between the peritoneal leaves of the iliac mesocolon and in three to herniation through the narrow peritoneal isthmus on the outer side of the colostomy, the affected loop of small bowel passing through this gap and becoming strangulated (Fig 173)

There were 25 obstructions within one month after operation. The others occurred some months or years afterward.

Recognition of late obstructions was easy, but diagnosis of obstructions in the immediate postoperative period was often difficult because of confusion with paralytic ileus. An important distinguishing feature of obstruction was the intermittency of symptoms. Differentiation between the various types of obstruction was usually impossible clinically

The initial treatment usually consisted of gastric suction and administration of fluids intravenously until a definite decision was reached regarding the presence of mechanical obstruction. Once such a diagnosis was made, laparotomy was done Adhesions were divided, hernias reduced and other lesions appropriately dealt with In no case was resection of the gut necessary

Of four patients with postoperative obstruction who were treated conservatively because of errors in diagnoses, all died. Of the other 33, all treated by operation, 3 died

The risk of obstruction of the pelvic floor might be minimized by suturing the pelvic peritoneum so as to bring the upper serous surfaces into apposition and turn the free edges downward, and by avoiding long catgut tails to the knots.

To prevent obstruction in the vicinity of the colostomy, the stoma should be made in the left iliac region rather than in the midline and the lateral space should be closed. Even with a left paramedian colostomy the left lateral space can be closed by using a running stitch between the iliac colon and the anterior parietal peritoneum (Fig 174) Closure of the lateral space with a left iliac colostomy is usually done by making a fair sized gridiron or muscle cutting incision in the left iliac region, drawing the iliac colon through this and pulling it downward and medially while the outer edge of the parietal peritoneum is retracted strongly laterally This opens up the lateral space and usually creates a fold of peritoneum running across it A purse string stitch is inserted along the fold from the left edge of the wound almost to the bowel. When tied, it effectively closes the space

Relief of Colostomy Stricture by plastic operation, using a principle previously employed for post-tracheotomy stricture, is described by Dean B Seabrook[9] (Portland Ore.) Whereas etiology and prognosis of stricture formation are

(9) West. J Surg. 60:20-24 January 1952.

obscure, once the slow, progressive contraction of the typi cal fibrous band (1/8-1/4 in wide, just beneath the junction of mucosa and skin) starts, operative relief is imperative de spite delay of complete stricture through finger dilatation or special apparatus When stomal diameter is reduced to 1 cm., obstruction ensues

TECHNIC.— An incision is made around the strictured colostomy stoma, after which two vertical incisions are extended from opposite dges of the wound, one being carried 5 cm. cephalad, the other 2.5 m. caudad. The bowel is dissected free to the fascia and the con ricting white fascial band removed The bowel opening is then en

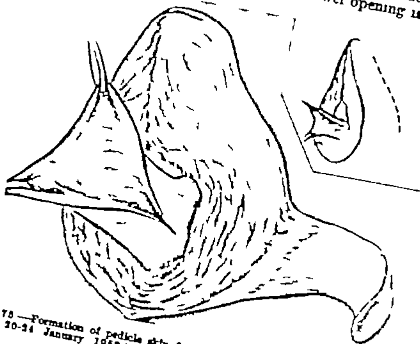


Fig 175 —Formation of pedicle skin flap. (Courtesy of Seabrook, D B: West. J Surg 60 20-24 January 1952)

larged by longitudinal incision almost to the fascia (Fig 175) A wedge-shaped pedicle flap is cut from the skin adjacent to the abdominal wall (Fig 175) and, after removal of excess fat, is sutured to the edges of the longitudinal incision like a gusset used to enlarge the sleeve of a garment (Fig 176) The knots are tied inside the bowel. Skin closure is effected (Fig 177) and a small rubber drain is inserted to the fascia, to be removed after 48 hours. Delay in healing is prevented by preoperative preparation of the bowel with sulfasuxidine* and aureomycin and restriction of bowel movements for five days postoperatively

Multiple operations have heretofore been necessary to relieve stricture, but four patients operated by this technic give convincing evidence that a stricture cannot develop

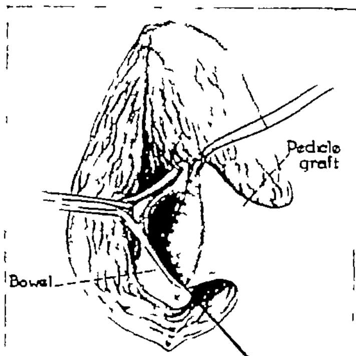


Fig 176—Skin flap in place (Courtesy of Seabrook, D B.: West. J Surg 60:20-24 January 1952)

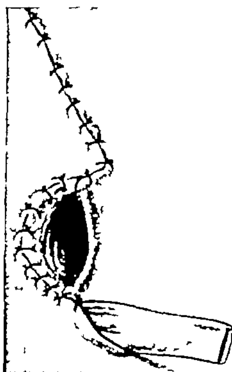


Fig. 177—Appearance of wound after completion of operation. (Courtesy of Seabrook, D B.: West. J Surg. 60 20-24 January 1952)

again although only 18 months have elapsed since the first patient was operated Moreover, such complications as bleeding, hernia or prolapse have not occurred.

Significance of Perineal Pain Following Resection for Carcinoma of Rectum was evaluated by John M. Beal and Franklin L. Ashley[1] (V.A. Hosp., Los Angeles) During four years, 66 patients had combined abdominoperineal resections, 18 of which were palliative for tumor that had metastasized to the periaortic nodes, liver, etc This report is concerned with 14 of the patients who had histologically demonstrable recurrence Of these, 75% had lesions which arose in the distal 10 cm of the rectum.

Local recurrence was established 6-30 months after abdominoperineal resection. Perineal pain was the prominent symptom in 18 patients, in 1, it appeared later Other symptoms were sacroiliac or -coccygeal pain, loss of sexual potency and bladder disorders. Pain was usually severe enough to require narcotics.

Evidence of perineural invasion was found in 13 patients, the perineural lymphatic vessels containing tumor emboli, especially in the myenteric plexuses Direct invasion of the nerve sheath and direct extension along the nerve fibrils were also found. Two had invasion of the sacrum at a foramen. Correlation between perineural invasion and lymphatic and venous invasion was not evident, six having no demonstrable lymphatic extension.

In three patients, direct attack on the palpable recurrent lesion in the perineum gave poor results. Presacral neurectomy was combined with local excision in one of these without symptomatic relief. Regional nerve blocks were of very temporary benefit. In six patients palliation was obtained with x ray therapy for varying lengths of time, with decreasing symptomatic relief on repetition. In one patient cordotomy gave satisfactory relief from pain, but usually referral for neurosurgery was too late for cordotomy

Other workers have pointed out that perineural extension and venous invasion indicate a grave prognosis. This is supported by the authors' observations. Correlation of pain in the perineum with local recurrence and with perineural extension is striking The implication is that persistent pain in the perineal region after abdominoperineal resection is

(1) Surgery 30 950-954 December 1951

almost conclusive evidence of local recurrence The difficulty in management of these cases and the frequent heavy dosage of narcotics required suggest that earlier consideration of neurosurgery is indicated

Functional Results after Sphincter-Saving Resections of Rectum for carcinoma, rectal prolapse, ulcerative colitis or polyposis coli were analyzed by J C Goligher[2] (St. Mark's Hosp) The 171 patients were treated by different types of resection. They were studied with regard to scope of excision as it affects the motor and sensory sides of the sphincter apparatus, objective effects on the component parts of the sphincter mechanism and quality of rectal function.

Anterior resection was done on 120 patients, leaving a rectal stump of 10 or more cm., occasionally 7 or 8 cm., above the anal orifice. Although frequency of movements was increased (decreased to two or three daily after several months readjustment), apparently due to loss of the normal fecal reservoir, *rectal function was perfect*

The invagination type of abdominoanal excision (Maunsell Weir operation), also an anterior abdominal resection but carried somewhat lower, was done in 18 cases The anorectal stump being much smaller cannot readily be anastomosed to the colon in the depths of the pelvis, instead, by means of stay sutures attached to its upper end, it is invaginated and drawn inside out through the anus (Fig 178, *A*) The colon stump is then pulled down through the everted anorectal stump until its cut edge lies opposite the lower (really upper) edge of the rectal remnant. The edges of both stumps are sutured together (*B*) The completed anastomosis is returned to the pelvis through the anus (*C*) and extraperitonealized from the abdominal cavity, a drain being brought out extraperitoneally from the region of the anastomosis through the lower end of the abdominal wound. This is done in the lithotomy Trendelenburg position so that two operators can work simultaneously from above and below In 14 of 18 patients, rectal sensation and control of flatus and feces (including liquid feces) were normal six or more months after operation. Four patients had postoperative incontinence with regard to flatus and liquid feces but not to solid feces, presumably because the anorectal

(2) Ann. Roy Coll. Surgeons England 8:421-439 June 1951

stump was only 6-6.5 cm long whereas it was 7 cm. long in the more successful cases.

Rectosigmoidectomy was done on 20 patients with prolapse The prolapse is drawn down as far as possible Then

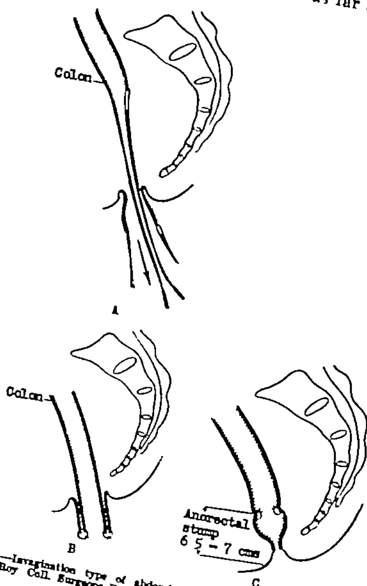


Fig. 178—Invagination type of abdominoanal excision. (Courtesy of Goligher J C Ann. Roy Coll. Surgeons England 8 421-439 June, 1951)

a circular incision is made 0 5 in. distal to the mucocutaneous junction. The inner tube of the rectum is pulled down, including the lower sigmoid, and sutured to the parietal peritoneum before the sigmoid is cut flush with the edge of the everted anal canal and the two lumens anastomosed.

Ten patients had fair control, but 10, although usually continent for solid feces, never had a proper spontaneous evacuation. They had frequent small movements of hard feces and sudden movements after taking aperients, with relative incontinence. *The poor results were apparently due to the* hypotonic state of the sphincter musculature and shortness of the anorectal mucosa left by the operation.

The "pull through type" of abdominoanal excision was done on five patients. The anal mucosa is sacrificed. The colon is pulled down through the anal orifice (Bacon's technic, Fig 179) and the sphincters are divided in the mid line posteriorly (Babcock's technic). The patients had poor

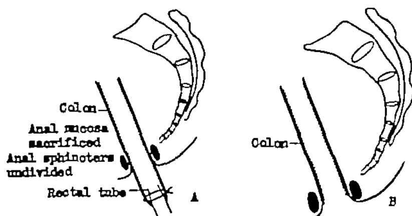


Fig. 179 — Pull through type of abdominoanal excision. *A*, at conclusion of operation; *B*, final condition. (Courtesy of Goligher J C. Ann. Roy Coll. Surgeons England 8:421-439 June 1951.)

results, with negligible active sphincter contraction and little control. Often the first indication of a movement was the *feel of feces on the skin of the anal region, a state probably* worse than that an orthodox abdominal colostomy produces.

Total colectomy and partial excision of the rectum with ileorectal anastomosis (Mayo's operation) was done on six patients with polyposis coli. Anatomically the sphincter apparatus is preserved as in anterior resection. Despite a more liquid character of the feces, the patients were continent with regard to flatus and feces six months later. Eventually stools diminished from 10 to 12 to 5 or 6 daily.

Total colectomy and excision of the rectum with pull through ileoanal anastomosis was done on two patients with ulcerative colitis. The anorectal musculature was pre

served but the mucosa removed Despite preservation of the sphincter muscles, there was incontinence because rectal sensation had been lost.

The following conclusions were drawn. The sensory function of the rectum must be safeguarded by retention of an anorectal stump (with its mucosa) at least 6 cm from the anal orifice and preferably 7-8 cm. The sphincter muscles must be retained undivided Low anterior resection is a reliable sphincter saving operation for rectal carcinoma. Of abdominal excisions, the Maunsell Weir invagination type gives the most satisfactory results. In performing rectosigmoidectomy for rectal prolapse, a cuff of at least 1 in. anorectal mucosa should be preserved. Although total colectomy with ileorectal anastomosis is followed by anal continence, colectomy and partial excision of the rectum, with drawing of the terminal ileum through the rectal stump denuded of its mucosa, are not satisfactory

Proctologic Manifestations of Carcinoma of Prostate Raymond J Jackman and James R Anderson[3] (Mayo Clin. and Found.) review 27 cases of prostatic carcinoma that had invaded the wall of the rectum obstructing its lumen. A common error was primary diagnosis of rectal carcinoma. Patients fell in three groups (1) 14 had prostatic carcinoma which produced an extrarectal mass that bulbed into the rectal lumen and prevented passage of the sigmoidoscope to its usual distance (2) 2 had prostatic carcinoma that encircled the rectum causing an annular hourglass type of stricture, and (3) 11 had prostatic carcinoma that invaded the rectal mucosa.

In some cases only minimal urinary symptoms were noted. Rectal obstruction became increasingly worse in several patients who had had orchiectomy or diethylstilbestrol therapy One patient had colostomy as a palliative measure

Sometimes, when obstruction is quite obviously entirely extramucosal, sigmoidoscopy will show an apparently normal rectal lining except for a narrowed ring of tissue or a large, bulging mass arising from the prostate. When invaded, the mucosa may bleed easily or a fungating growth will be seen In men with rectal carcinoma with any urinary symptoms, cystoscopy should precede radical operations for rectal lesions. Biopsy of rectal lesions should be routine.

(3) Am. J Surg 83:491-494 April, 1952.

Surgical Management of Congenital Malformations of Anus and Rectum Report of 111 Cases Harry E Bacon (Philadelphia) and Lloyd F Sherman[4] (Minneapolis) state that imperfections in normal developmental pattern of anus and rectum in the 6th 9th week of fetal life are responsible for congenital malformations in this area. Incidence of abnormalities is 1 5,000-10 000 births Of 111 patients, 29% had coincident congenital anomalies elsewhere in the body

Anal anomalies such as stenosis of the anal canal and imperforate anus result from improper absorption of the anal plate in the 8th fetal week Abnormal anal location occurs with under or overdevelopment of the urorectal septum.

Rectal anomalies such as nonfistulous absence of ampulla or supra ampullary segment result from persistence of the solid stage of either the ampulla or the supra ampullary portion of the rectum Fistulous anomalies of the rectum are usually coincident with absence of ampulla or with anal malformations The anomaly results from incomplete downward extension of the mesenchymal urorectal septum or a primary failure of the cloacal duct to disappear

Diagnosis of anal stenosis and imperforate anus is not difficult. Diagnosis of absence of ampullary or supra-ampullary segment of the rectum frequently with concomitant fistulas in the former, is more difficult. "Inversion x ray" with radiopaque marker over the anal dimple and the child inverted usually shows the blind end of the rectum full of air The injection of contrast mediums into a fistulous tract aids diagnosis. If the child has had emergency colostomy the distal colostomy limb can be filled with radiopaque material

If the anomaly has no vent for egress of feces some type *of decompression is mandatory With stenosis or a* large fistula, definite surgery can be postponed and no diversionary procedures are necessary Anal anomalies including occasional concomitant fistulas may ordinarily be corrected by perineal operative procedures A partially persistent anal

(4) A.M.A. Arch. Surg 64 331-344 March, 1952

membrane, may be excised completely or incised, with free margins sutured to sphincter ani muscle fibers. Mural stenosis of the anal canal is most successfully treated by anoplasty Complete imperforate anal plates may be incised with cruciate incisions, skin edges trimmed, or the tip of each quadrant may be lightly sutured to the sphincter muscle Abnormally located anal canals can be transplanted to normal location by modified Rizzoli procedure

Congenital rectal malformation usually requires transverse colostomy Abdominoperineal surgery is postponed until the child is at least 3

Of 111 patients, 64 had rectal anomalies, 62 5% with associated fistulas 45.3% of the whole group had fistulous tracts between rectum and vagina The Rizzoli method is best for rectovaginal fistulas Operative mortality for 108 patients was 6 4%

Anal Infections Encountered in General Practice require thorough diagnostic evaluation and early treatment to prevent chronic disabling complications. Actually, 85% of anorectal disease can be diagnosed by inspection, palpation and anoscopic examination. Sigmoidoscopic examination to the 10 in. level is also an important aid.

Malcolm R. Hill[5] (College of Med. Evangelists) points out that anal infections are caused by invasion of anal ducts, glands and regional tissues by pathogenic bacteria, the result of funneling of fecal material into the crypt (Fig 180) Microscopy confirms the impression that localized cellulitis involving duct and gland structures usually constitutes an early stage in the process, and invasion follows the microscopic channel of the anal glands. Invasion may be through local trauma, from obstruction and distention of the glands or indirectly, by lymphatic avenues.

In diagnosis, anorectal inflammatory disease falls into two classes, depending on the avenue of infection (1) direct, including fissure in ano, abscess and fistulous disease (Fig 181) (2) indirect, including hypertrophy of anal papillae and contracture or stenosis of the anus. Hemorrhoids, representing anastomoses of systemic and portal veins in the supporting tissues of the anorectal outlet, are near the anal ducts and glands and therefore are also vulnerable to infection. Secondarily, periphlebitis and phlebitis of these vari

(5) California Med. 75:89-93 August, 1951.

cose elements produce acute swelling, capillary congestion and rupture with extravascular and intravascular thrombosis ("strangulated hemorrhoid")

Symptoms of anal infection include (1) alteration in bowel habit, in which ease and completeness of evacuation and the presence of protrusion or prolapse of tissue mass are factors. (2) Bleeding suggests a lesion in the lower colon, rectum or anus. Anoscopic and sigmoidoscopic examination

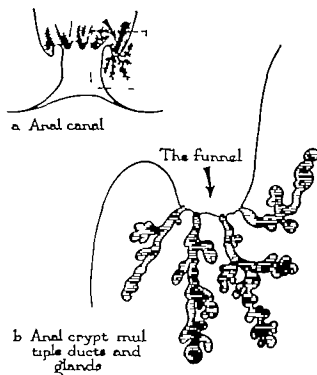


Fig 180—Anal canal and crypt with "funnel" relationship to contiguous ducts and glands. (*Courtesy of Hill, M. R. California Med. 75 60-62, August, 1951; after* Hesselrod, J P Proctology in General Practice [Philadelphia: W B. Saunders Company 1950])

should be done (3) Pain is usually dull aching or throbbing but may be acute (4) Swelling of acute progressive type with pain and fever indicates abscess Sudden swelling with stinging pain around the anal margin indicates hemorrhoidal thrombosis, sometimes associated with regional infection. (5) Purulent anal discharge indicates fistula or malignancy If persistent, pruritus ani, prolapsing hemorrhoids perineal laceration or similar lesions may be the cause (6) Loss of weight, often accompanies chronic anorectal infections, in

cluding chronic ulcerative colitis and fistulous disease associated with lymphopathia venereum.

Fissurectomy calls for surgical removal of the ulcer bearing area including subcutaneous gland bearing tissues, associated crypts and ducts, hypertrophic anal papillae together with associated varicosity and sentinel pile formation external to the lesion, with institution of drainage at the skin

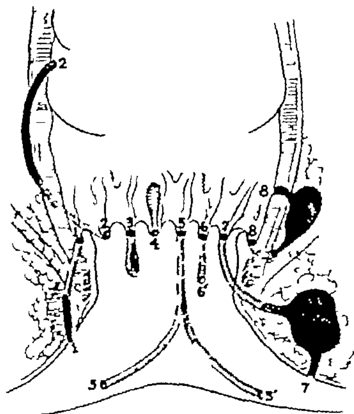


Fig 161—Anorectal canal, showing variable pattern of infection spread from crypt line. Complete fistulas 1 2 5 6, 7 8 are primary and 1' 2' 5' 6' 7' 8', secondary openings. Stasis formation with possible fissure and ulcer formation, 3 and 4 Abscess ischiorectal 7-7' supralevator 8-8' (Courtesy of Hill, M. R. California Med. 75 89-93 August, 1951; after Nesselrod, J P: Proctology in General Practice [Philadelphia W B. Saunders Company 1950])

margin. Partial posterior sphincterotomy relieves sphincter spasm postoperatively and lessens contracture and stenosis accompanying the chronic infection originating in crypt, duct or gland.

The longer an acute abscess about the anorectal canal is allowed to exist, the greater the likelihood of tissue destruction with muscle damage. Early surgical drainage is far better than delay until pointing and spontaneous evacuation

of pus T-shaped or elliptical incisions paralleling and cutting the muscles are used, followed by scalping the abscess, saucerization and bevelling skin edges, breaking up all loculi. This makes a complete fistula. Mucosal abscesses are preferably opened by cautery Rubber tissue drainage is used.

In cases of confirmed fistula, prompt fistulectomy is done after control of infection. The primary opening of the fistula is usually at the orifice of an anal crypt (Fig 181) The fistula may be incomplete (blind) or complete, with the secondary opening externally, submucosally or in another organ. Since tuberculosis or cancer may attend these chronic infections, biopsy is mandatory All diseased tissue is removed, including the primary and secondary openings and communicating tracts with the related crypt, duct and gland elements. Wide surgical and dependent drainage, removing enlarged papillae and adjacent hemorrhoidal varicosity, is essential for uniform healing Sphincter muscle fibers are cut at right angles to the line of cleavage since sphincteric preservation and restoration are important. Placing a seton about a muscle bundle to allow for healing of large excavating wounds is preliminary to secondary incision of the sphincter and removal of the seton This permits the residual shallow groove to heal progressively

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KIDNEY

Management of Urologic Accidents in General and Gynecologic Surgery is discussed by Hjalmar E. Carlson[6] (Kansas City, Mo) An incision of the kidney during surgery is usually deliberate to help diagnose an unexplained retroperitoneal mass If the renal capsule is tightly closed, with mattress sutures over fat to control bleeding, no complications should develop

Simple incision of the ureter should be approximated with 00 chromic catgut and the ureter drained extraperitoneally Healing of a transverse incision in the ureter can be helped by a ureteral catheter If a ureteral incision is not recognized during surgery profuse drainage through the wound will show damage to the urinary tract. If a catheter can be passed to the kidney and a pyelogram obtained, the cath

(6) South. M J 44:744-749 August, 1951

eter should be left in place for drainage A simple incised wound will heal spontaneously, if it continues to drain an operation is necessary A completely divided ureter which is recognized during surgery should be sutured over a splint ing catheter When it is not recognized at operation, there is profuse drainage of urine through the incision or into the pelvis where an abscess forms and later ruptures into the vagina creating a ureterovaginal fistula Management of ureterovaginal fistula varies with the length of ureter available Operation is most favorable three months or longer after original surgery, as this will allow for healing and make repair of the damaged ureter easier

Cystoscopy will determine the length of ureter available and particularly the side involved. After preliminary study, a suprapubic extraperitoneal approach is made and the ureter freed from its point of attachment to the vagina. The bladder is opened and the ureter inserted through a stab wound in the bladder The ureter and bladder are then drained. If the ureter is severed near the pelvic brim, anastomosis may be possible If the ureter is too short to be anastomosed to the bladder a tonguelike flap of bladder wall can be brought up to the short ureter

If the ureter has been ligated with catgut it may be possible to push a catheter up the ureter two or three weeks after the ligation. If silk has been used a preliminary nephrostomy followed by deligation and repair of the ureter is necessary When both ureters have been ligated, deligation should be performed if the patient's condition is good. If the patient's condition is poor, nephrostomy is the choice.

Crushing or stripping of the ureter usually results in sufficient degeneration of the wall to form a fistula Excision of a portion of the ureter may necessitate nephrectomy or anastomosis of the ureter to the transverse colon.

Simple incision of the bladder is corrected by a layer of interrupted chromic catgut followed by a continuous layer of catgut. A small drain is inserted down to the area and a urethral catheter is inserted. Two thirds of the bladder can be resected with little change in function. Unrecognized resection of the floor or posterior wall of the bladder results in a vesicovaginal fistula. It is best to wait three months or longer before repairing the fistula. The approach may be vaginal, transvesical or transperitoneal.

In radical surgery on the rectum and to a lesser extent on the female reproductive organs, some difficulty in urination is caused by interference with nerve supply A retention catheter may be used for a period of weeks Most patients will void well after eight weeks and resection of the vesical neck is rarely necessary

Injuries to the urethra during surgery of the female genitalia are not common and are readily repaired, injuries to the male urethra may occur during the opening of a suspected rectal abscess which may in reality be a periurethral abscess. Healing is spontaneous if no stricture of the urethra is present.

Alterations in Renal Function Associated with Surgical Procedures Their Physiology and Management were studied by Merrill W Schell[7] (Nashville Tenn.) He lists 11 conclusions regarding temporary postoperative renal abnormalities. (1) Excretion rates of positive loads of Na, Cl and water are very small in man in the immediate postoperative period especially in the first six hours. (2) With positive loads of Na and Cl in excess of the positive loads of water Na and Cl urine concentrations remain low throughout the first 30 hours after anesthesia (3) When isotonic saline is given postoperatively combined renal and insensible losses of water from the body are relatively faster than the loss of salt, more salt than water being retained, making NaCl concentration in the retained fluid greater than it was in the infusate and in plasma (4) The aforementioned relations of the rate of excretion of water and of salt are the converse of those in normal patients (5) Continuous high rates of tubular reabsorption of water Na and Cl, regardless of various influences that tend to lessen them, are possible immediate causes of some of these postoperative renal function changes (6) One hour of ether anesthesia per se has no significant effect on water or salt excretion. (7) Afferent stimuli of traumatic origin may be an inciting cause of the renal functional changes (8) The anomalous renal functions may exist after other forms of trauma besides surgery (9) Temporary increases in adrenocortical function play a significant part in postoperative salt and water retention. (10) Hormonal imbalance produced postoperatively

(7) Am. Pract. 2 868-881 October 1951

with excess liberation of antidiuretic hormone, may be a factor (11) Volume, solute concentration and composition of the infusate should be carefully considered immediately after operation, during which time isotonic NaCl solution should not be considered "physiologic" repair solution.

Rapid flow of urine should not be forced by injection of 5 or 10% glucose in distilled water during postoperative inhibition of water diuresis because of real danger of inducing water intoxication The amount of glucose in water to be given should be limited to the patient's need for water, usually 1,000-2,000 cc Saline solutions should not be given during the immediate postoperative period unless there is a specific indication, such as signs of extracellular fluid volume deficit and rapid Na losses through suction, tubes and fistulas If saline is indicated, a 0 6-0 7% solution is preferable to a 0 9 or 0 45% solution If Na is required in the presence of normal or low carbon dioxide-combining power, Hartmann's solution should be given because it will not produce dilutional acidosis If saline solution is needed while carbon dioxide combining power is elevated NaCl solution should be given.

Pre-existing or concomitantly developing salt, water protein and red blood cell deficits, disturbances in osmotic balance and diminished renal blood flow may aggravate and prolong the temporary disturbances of renal function.

The main factor in pathogenesis of lower nephron nephrosis is renal anoxia The ischemia depending on duration, may produce reduced function without tubular damage reversible damage to nephrons and finally irreversible renal damage with failure and death. Other factors include precipitation of heme pigments in the tubules and nephrotoxic substances liberated from injured tissue The salient clinical manifestation of lower nephron nephrosis, common to all conditions that may cause it is rapidly progressive renal insufficiency first manifested by oliguria which progresses to anuria pronounced retention of nitrogenous and other waste products, increased potassium retention, variable amounts of edema and acidosis.

Thorn's résumé of treatment and misconceptions regarding lower nephron nephrosis follows (1) Use adequate whole blood to restore a normal circulating volume during

the period of shock. (2) Regulate total fluids carefully so that no gain in body weight occurs during anuria. (3) Total fluid intake per day does not usually exceed 1,000-1,500 cc. in absence of fever, vomiting, diarrhea or other unusual loss. (4) Provide a high calorie intake and infuse 15 per cent glucose solution to reduce endogenous protein breakdown and potassium retention. (5) Use small quantities of plasma (250 cc.) and serum albumin (10-15 Gm.) daily in the glucose to maintain blood volume and prevent excessive fluid loss into extracellular spaces (6) Digitalization should be carried out at the first evidence of cardiac enlargement or pulmonary congestion. (7) More severe cases of lower nephron nephrosis may require removal of nitrogenous waste after 7 10 days by renal decapsulation, continuous gastric lavage, peritoneal irrigation or use of the artificial kidney (8) After onset of diuresis is evident, water and salt must be restored in adequate amounts.

Renal Function Studies of Severely Burned Patients, involving 16 observations, were made on eight severely burned patients with 15-80% body surface involvement by B W Haynes, Jr., Michael E. DeBakey and F R. Denman[8] (Baylor Univ) Fluid intake was adequate to maintain above 100 cc./hour urinary output. Nitrogen retention did not occur Electrolytes, plasma and whole blood were used as required to counteract early plasma loss and later anemia. Hematocrit readings were kept above 40% Blood pressure was within normal range and shock did not occur

Observations included glomerular filtration rate, effective renal plasma flow, maximal tubular excretory capacity, plasma volume and thiocyanate space The fraction of plasma filtered at the glomerulus (filtration fraction, per cent) was obtained by dividing the glomerular filtration rate times 100 by renal plasma flow

During the first 2½ weeks after injury and starting the second day glomerular filtration rate was usually above or in the upper limits of normal range, with a tendency to fall to normal levels during this period. Renal plasma flow showed no change from normal, giving an increased plasma filtration fraction because of increased glomerular filtration rate with unaltered renal plasma flow These values tend to reach normal about 2½ weeks after injury Shortly after

(8) Ann. Surg. 134 617-625 October 1951

injury, tubular function was normal, but with time excretory capacity appears to increase One patient died 25 days after burn but renal failure was not a factor

Normally overhydration with saline solution produces the same functional pattern as thyroxin, i.e., increased glomerular filtration rate, increased renal plasma flow and resultant unaltered filtration fraction. Therefore, the large intake of fluid to counteract expansion of extracellular space, as measured by sodium thiocyanate (to 98% in larger burns) is not attributable to increased hydration per se as renal plasma flow did not increase in these patients

Desoxycorticosterone acetate greatly increases glomerular filtration and moderately increases renal flow causing increased filtration fraction. This pattern is similar to that in burns in its resultant filtration fraction.

Fever, or pyrogen without fever, produces a steady glomerular filtration rate, an increased renal plasma flow and a reduced filtration fraction. This pattern, however, differs from that of the burned patient

Treatment of hypoproteinemia with human serum albumin produced a short lived (under 24 hours) fall in filtration fraction through a disproportional rise in plasma flow However, hypoproteinemia does not usually concur with the peak of increased filtration rate Therefore the concept that increased glomerular filtration rate without increased renal plasma flow in hypoproteinemia produces increased filtration fraction does not adequately explain the observations. Other forces may be more important.

The data do not resemble epinephrine response of maintained filtration rate with reduced renal plasma flow and consequent increased filtration fraction. With increased filtration rate and renal plasma flow and associated normal filtration fraction, as might be expected from increased extracellular space determinations, addition of epinephrine might sufficiently diminish renal plasma flow (through efferent glomerular vasoconstriction) to maintain an already elevated filtration rate and thus produce an increased filtration fraction. As this type of pattern persisted 2½ weeks, it would suggest that epinephrine is not the effector agent.

It appears that certain known physiologic variables produce relatively characteristic renal functional changes which resemble the pattern observed in burned patients The most

applicable variables apparently are (1) overhydration, (2) increased thyroxin output, (3) hyperadrenalism, especially desoxycorticosterone acetate, (4) pyrogenic response, (5) hypoproteinemia and (6) increased epinephrine activity On the basis of this preliminary evidence, one or a combination of these variables would not explain the changes observed. Nevertheless one can conclude that severely burned patients adequately treated exhibit a degree of renal functional compensation compatible with complete recovery

Mechanism of Electrolyte Imbalance Following Ureterosigmoid Transplantation is analyzed by Jack Lapides[9] (Univ of Michigan) because of frequent intermittent postoperative anorexia, nausea, fatigue and fever episodes and occasional nitrogen retention. These symptoms are associated with hyperchloremia and acidosis Studies included (1) blood electrolyte studies, excretory pyelography and postmortem examinations on patients and dogs after bilateral ureterosigmoid transplantation and (2) observations of effects of rectal urine instillation on electrolyte balance of three patients with normal and three with abnormal renal function.

Electrolyte studies of 22 patients showed 6 symptom free and in electrolyte balance at all times. The other 16 were in electrolyte imbalance, often with hyperchloremia (13 cases) and decreased carbon dioxide combining power (11 cases), although blood urea nitrogen was normal and had intermittent recurrent attacks of flank pain with fever malaise nausea and vomiting Hyperchloremia was most severe in a patient with borderline renal function before surgery Electrolyte studies of four dogs with ureterosigmoid transplants showed similar values.

Normal electrolytes excretory pyelograms and clinical conditions were found in 23% of patients. Abnormal pyelograms (either hydronephrosis or nonvisualization of collecting systems) were encountered at some time postoperatively in 77% The pyelographic disturbances were often temporary ordinarily preceded by recurrent intermittent attacks of flank pain and fever and often associated with hyperchloremia and acidosis Hydronephrosis sometimes appeared months and even years after operation, apparently the result of recurrent infection at the ureterointestinal meatus

(9) Surg., Gynec. & Obst. 93 691 704 December 1951

Autopsies revealed varying degrees of pyelonephritis. Pathologic changes in the tubule without diffuse glomerular changes have been noted by other workers in three autopsies and correlated with Albright's "renal acidosis resulting from tubular insufficiency without glomerular insufficiency." This further correlates with obvious mode of origin, namely, ascending infection.

On the basis of these studies there are three groups of patients (1) those with normal electrolyte balance, no demonstrable kidney infection and with homeostasis maintained despite colonic absorption of urinary constituents, (2) those with persistent postoperative electrolyte disturbances based on poor preoperative renal function which after surgery becomes inadequate for the excessive burden of absorbed urinary constituents, causing hyperchloremia with acidosis (but normal blood urea nitrogen as long as the glomeruli are not involved) and (3) those in whom electrolyte imbalance develops months or years after surgery as a result of increasing involvement of tubules by pyelonephritis episodes leading to deterioration of kidney function, although often there are remissions when infection abates.

Comparative observations in two groups of three patients with good and with poor renal function (none having had ureterosigmoid anastomosis) were made when both groups were given continuous urine rectal drips for several days. Patients with good renal function were not disturbed by urine instillations, whereas those with poor renal function went into electrolyte imbalance (Colonic x-ray studies showed that urine reached the cecum in these patients.)

Lapides concludes that electrolyte imbalance is caused primarily by renal tubular damage and secondarily by intestinal absorption of urinary constituents. Resorption of urinary constituents from the colon is common after ureterosigmoid anastomosis but hyperchloremic acidosis occurs only if renal function is poor. Development of electrolyte imbalance in these patients is determined by occurrence of impaired renal function.

Treatment of Uremia by Perfusion of Isolated Intestinal Loop E E Twiss (Rotterdam) and W J Kolff[1] (Cleveland) kept a man alive for 46 days after removal of the

(1) J A M A 146 1019 1022, July 14 1951

only functioning kidney by dialysis through an isolated intestinal loop

Man, 36, had right nephrectomy for infected hydronephrosis. He had anuria for 10 days, exploration of the left side revealed an aplastic kidney A loop of small intestine 2.5 m. long was prepared, *and the two orifices were sutured to the abdominal wall.* The left aplastic kidney was able to produce some urine. During the next 46 days the aplastic kidney produced 140 ml. urine daily and excreted 0 6 Gm. urea daily The blood urea rose steadily to 369 mg /100 ml. on the 16th day after nephrectomy and daily perfusions through the intestinal loop from the 10th to 18th day lowered this slightly By treatment with the Kolff artificial kidney on the 19th and 24th day the urea was reduced to 167 mg /100 ml. On the 29th day a new series of perfusions through the isolated intestinal loop was performed. The blood urea level was kept at about 200 mg /100 ml. *until shortly before the patient died.*

The patient was fed intravenously with 1 L. of 40% dextrose daily to which insulin, penicillin and vitamins were added. Disruption of the wound and wound hemorrhage developed on the 20th day and had to be sutured. Thrombi developed along the polyvinyl catheter through which the intravenous fluids had been given. Multiple emboli appeared throughout the body, including the lungs and brain. The patient died after 46 days.

During the 16 days of intestinal perfusion, from the 29th to 46th day an average of 8 6 Gm. urea a day was removed during the 8-10 hours of perfusion. The blood creatinine and uric acid did not increase. Early during the perfusion the patient absorbed much water and sodium chloride *from the irrigating fluid. Further absorption of* water was prevented by increasing the osmotic pressure of the rinsing fluid by the addition of sucrose, dextrose or magnesium sulfate This allowed the water to b thdrawn, though sodium chloride was still absorbed. Edema uring use rfusion fluid and it was necessary to the exce d water by decreasing the sodium cl nt of th n fluid. A "diuresis" of 1.5 L. a day intesti the aver age daily loss of 6 Gm. as the While the patient was absorbing so the b e rose to hyp levels. Wh chl thdrawn th the bloo to hy assium le to 1 testinal -dio al level of s Calcium p t abso e provi ven a as h ert t

sodium chloride, 0-150 mg./100 ml., potassium chloride, 0-40 mg./100 ml, calcium chloride, 0-28 mg/100 ml., and sodium bicarbonate, 100-200 mg/100 ml.

ADRENAL GLAND

Surgical Treatment of Hyperfunctioning Lesions of Adrenal Cortex. Waltman Walters[2] (Mayo Clinic) points out that recent developments in the physiology of the adrenal cortex have aided in the diagnosis and treatment of adrenal cortex diseases. Metabolic studies and identification of the urinary excretory products of the adrenal steroids has further clarified the pathologic physiology of adrenal cortex lesions Twenty-seven complex steroid have been isolated from the adrenal cortex. Deoxycortone is the most familiar It affects principally the metabolism of salt and water and is used in Addison's disease Cortisone and compound F of Kendall have an effect on carbohydrate and protein metabolism. Overproduction of these two hormones leads to diabetes mellitus, negative nitrogen balance, muscular wasting weakness, osteoporosis, thinning of the skin and ecchymosis Practical methods are available for estimating some of the excretion products of these hormones in the urine. Compounds A and B probably influence the metabolism of fat. Obesity is one of the outstanding features of some patients with hyperfunctioning lesions of the adrenal cortex. These hormones are part of a group, the urinary excretion products of which are measured collectively as the so-called glycogenic corticoids or corticosteroids

Androgenic compounds of the adrenal cortex will sometimes produce virilism. Overproduction of estrogens and compounds which have a progesterone-like action is occasionally seen in hyperfunction of the adrenal cortex. Patients with virilism usually excrete a large amount of 17 ketosteroids in the urine

There is no single syndrome characteristic of adrenal cortex overactivity The sexual changes produced by adrenal cortex tumors are among the most spectacular Surgery, if possible, is the best treatment. Administration of adrenal cortex extracts before, during and after operation has pre

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(2) Lancet 1 221 225 Feb. 2, 1952

vented deaths from adrenal cortex insufficiency after removal of these tumors

Kepler has demonstrated the important part played by the adrenal glands in Cushing's syndrome with and without basophilic adenomas of the hypophysis Subtotal adrenalectomy has been done at Mayo Clinic in 29 cases, with excellent remission of symptoms in 19 Adrenal cortex insufficiency in the immediate postoperative period has been controlled by administration of potent adrenal cortex extracts and, more recently, cortisone, which has alleviated the delayed symptoms of nausea, vomiting, weakness, and appetite and weight loss which have appeared in some cases two to four weeks after surgery

Surgery of Adrenals is done to remove neoplasms or to abolish functional activities which are deleterious, according to Charles Huggins and Delbert M. Bergenstal[3] (Univ of Chicago) Certain adrenal cortical tumors have androgenic effects (virilism) and occur exclusively in young persons, others, which are rare, have estrogenic effects, and some have corticoid effects (Cushing's syndrome) Bilateral adrenal cortical hyperplasia without tumor can also cause Cushing's syndrome Except for the sympathetic ganglion tumors which occur especially in childhood and are often highly malignant, the adrenal medullary tumor of importance is the pheochromocytoma Symptoms are those of paroxysmal or persistent hypertension, which is due to secretion of l nor-epinephrine or l-epinephrine by the tumor Lowering of the blood pressure by the adrenergic blocking agent, piperoxan, and induction of a hypertensive rise by injection of histamine are of diagnostic value

The authors prefer the posterolateral approach to the adrenal gland, and point out that the principal adrenal vein which is found on the anterior surface of the junction of the middle and lower thirds of the gland must be ligated. The most important factor in surgery is the anticipation, prevention and control of postoperative adrenal cortical insufficiency With the availability of desoxycorticosterone acetate and cortisone, this has been greatly facilitated In addition to the all important administration of adequate amounts of these agents, other important factors are replacement of blood lost at operation maintenance of blood pres-

(3) J A. M. A. 147 101 106 Sept. 8 1951

sure during operation by slow intravenous injection of l nor-epinephrine and avoidance of intravenous injection of massive amounts of fluids On the sixth postoperative day, maintenance dosage of cortisone acetate (37.5 50 mg daily by mouth) is usually begun, supplemented by 2-4 Gm. NaCl orally

Bilateral partial adrenalectomy is effective in control of Cushing's syndrome secondary to bilateral adrenal cortical hyperplasia Subtotal bilateral adrenalectomy and total adrenalectomy may be of some value in essential hypertension, but too few operations have been performed for evaluation. In two patients with metastatic carcinoma of the prostate, who relapsed after remission induced by antiandrogenic control, results of total adrenalectomy were encouraging When widespread and distant metastases are not present, excision of adrenal tumors, cortical and medullary, alleviates the symptoms.

EXTREMITIES AND SPINE

Chronic Edema of Lower Extremities is discussed by Fernando Martorell[4] (Barcelona) Edema is the manifestation of disturbance of interchange between intercapillary and interstitial fluids. Interstitial plasma forms the basis of fluids which pass through arterial capillaries, undergoes changes due to local cellular metabolism and is reabsorbed primarily by venous capillaries Substances of coarser molecular structure and insoluble foreign bodies cannot enter the blood without purification. They travel through the lymphatics which empty into the venous system, passing through at least one lymphatic ganglion where they are partly transformed and some retained. Interstitial plasma which enters by the arterial route leaves through both venous and lymphatic routes For this reason edema has two fundamental causes disturbance of venous circulation (venous edema) and of lymphatic circulation (lymphedema)

Venous edema is distal, depressible and easily reducible by recumbency It *often* causes dermatitis, pigmentation and ulcers. Causes are deep valvular insufficiency (essential

(4) Angiology 2:434-440 December 1951

or postphlebitic), venous obliteration and, rarely, a congenital or acquired arteriovenous fistula. Postphlebitic venous insufficiency is characterized by a bland distal edema which is reduced by recumbency, is absent in the morning and increased at night Feet are cold and slightly cyanotic and patient has sensation of weight in the extremities. In uncompensated venous obliteration, edema increases on walking whereas in valvular insufficiency it decreases. Treatment of the latter by deep ligation usually increases edema. The best treatment for venous edema without complications is use of an elastic stocking and observance of a mode of living that will not encourage stasis.

Compared with venous edema, lymphedema is less common, harder, scarcely depressible less reducible by recumbency, with total or rhizomelic localization It is divided into congenital, essential and secondary types In simple congenital lymphedema there is swelling of all parts of the leg *of neither familial nor hereditary character The general* condition is good and no inflammatory or neoplastic condition interferes with lymphatic drainage The only efficacious treatment is excision. Essential lymphedema begins slowly on the foot or heel of one side, progresses to the top of the leg and results in progressive deformity It is usually found in young women and may originate from some endocrine factor Treatments indicated are lymphangioplasty and delimiting cutaneous plastic surgery Secondary lymphedemas include those of a tuberculous, neoplastic, postphlebitic or postlymphangitic nature

Venous edema and lymphedema favor streptococcic infections, which provoke fibrous hyperplasia of the skin subcutaneous cellular tissue and aponeurosis Finally the edema is converted into a fibroedema, an irreversible process irreducible by recumbency and corresponding in part to elephantiasis. Among leg edemas of surgical interest is the syndrome of erythrocyanoid lipedema, an orthostatic edema with adiposity of legs forming a supramalleolar ischemia with coldness, cyanosis and ulcers This occurs only in women, is always bilateral does not involve the feet and usually appears during puberty Lumbar sympathectomy cures the ulcers, improves the color of the limbs and raises foot temperature but only slightly reduces size of the leg

Marsupialization Operation for Pilonidal Sinus Comparison with Other Surgical Methods in 359 Cases On the basis of a follow up study in 92% of these cases for an average of nearly two years, Knowles B Lawrence and William J Baker[8] (V.A. Hosp., West Roxbury, Mass) found marsupialization to be the most comfortable operation for the patient and to cause him the least loss of time both in the hospital and thereafter It also was the most economical for

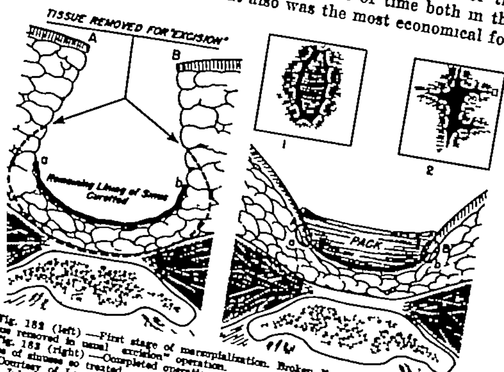


Fig. 182 (left) —First stage of marsupialization. Broken line indicates additional tissue removed in usual "excision" operation.
Fig. 183 (right) —Completed operation. Insets 1 and 2 show surface views of two types of sinuses so treated.
(Courtesy of Lawrence, K. B., and Baker W J: New England J Med. 245 134 139 July 26 1951.)

the Armed Forces. This operation insures healing with relative certainty and a low recurrence rate It avoids the extremely slow healing often encountered after complete excision of a large sinus.

More than half the patients had a history of definitive surgical treatment elsewhere or at least one incision and drainage for acute abscess previously Excision with primary suture was performed in 187 cases and was found to be effective only for small, clean sinuses. In the larger, chronically infected or otherwise complicated sinuses rate

(8) New England J Med. 245:134 139 July 26 1951.

of breakdown and infection in the hospital was 13% and incidence of recurrence after leaving the hospital 27%—a net total of 37% failures for the primary closure operation. The technic included excision of the entire pilonidal sinus with conservative removal of skin and surrounding fibrous and fatty tissue. Flaps composed of gluteal fascia and muscle were elevated by sharp dissection from the posterolateral margins of the sacrum on either side and were sutured together in the midline and to the postsacral fascia or aponeurosis with catgut. In most cases a continuous subcuticular suture of steel wire closed the wound.

Cautery and scalpel excision with packing was used in 45 cases, but healing time was long averaging 129 days, and recurrence rate was 33%

Marsupialization was used in 127 cases Average hospital stay was 6 3 days compared with 15 days for primary closure and for excision and packing Average period of healing was 43 days. Over-all cure rate was 84%, which could be improved considerably by omission of cases of recurrence, particularly those in which suture material was retained from previous operations. Recurrences were small in size and generally not troublesome.

TECHNIC.—The sinus is laid open for its full length, the skin incision being made as close to the midline as possible. Any lateral sinus tracts or pockets are laid open also If this cannot be done through the same skin incision, a T or Y extension is made. Loose, chronically infected granulation tissue and hair nests are curetted out, any septums or lateral pockets are opened and the sinus lining is curetted down to its base of rather firm scar tissue. Overhanging skin edges are excised conservatively It is not necessary to excise completely the fibrous portion of the sinus wall since this tissue must regrow in any event in the course of healing (Fig. 182) Skin edges are then sutured down to the lateral margins of the scar tissue bed of the sinus so that the wound is converted into a saucer or groove, with the fibrous wall of the cavity exposed only at the bottom. Plain catgut (00) is used and left in place four to six days, which is long enough for the lateral skin margins to adhere. An iodoform pack placed in the wound at operation usually loosens in two or three days and can be removed, after which use of antiseptic irrigations or wet dressings may be helpful in treatment of the larger defects of the marsupialized sinus (Fig 183) for the smaller defects, daily showering and a plain gauze dressing suffice.

ANESTHESIA

Edited by

STUART C CULLEN M D

PREMEDICATION

Effects of Potent Analgesics on Vestibular Function were studied in man by cold micro-caloric and galvanic stimulation methods. Vestibular responses to morphine, meperidine, codeine, methadon, pantopon® and acetylsalicylic acid were investigated by Leonard B Gutner Wilbur J Gould and Robert C Batterman[1] (New York Univ Bellevue Med. Center)

Morphine meperidine, methadon and pantopon® increased labyrinthine sensitivity whereas codeine decreased it. Acetyl salicylic acid did not change vestibular function. Meperidine increased reaction in the cold microcaloric test in both supine and ambulant patients, with greater response in the latter

Increased labyrinthine sensitivity produced by these drugs partly explains the higher incidence of untoward reactions noted when these therapeutic agents are used in ambulatory patients The authors however do not feel that this is the entire explanation, since administration of codeine which depresses vestibular function, still has the same incidence of untoward reactions in ambulant patients. Other contributing factors to this phenomenon may be stimulation of the cerebroemetic center alterations in cerebral blood flow and changes in cardiovascular dynamics

The authors also noted that dimenhydrinate can overcome the increased vestibular response produced by the drugs tested.

Effect of Intravenous Administration of Meperidine on Circulation of Man and on Circulatory Response to Tilt was studied in 26 subjects by Benton D King John D Elder Jr and Robert D Dripps[2] (Univ of Pennsylvania) Each

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(1) J Clin. Invest. 31 259 266, March, 1952.
(2) Surg., Gynec. & Obst. 94 591-597 May 1952.

subject acted as his own control. *Tilting to a 60 degree* head up position after 100-150 mg meperidine intravenously increases incidence of circulatory collapse from this postural change. Incidence of circulatory collapse from tilting is much lower after meperidine than after morphine in subjects past 40

Studies of other effects of meperidine intravenously suggest that the drug liberates histamine, for a wheal and flare appeared along the vein used for the injection The effect could cause vasodilatation and explain the circulatory collapse during tilt. Collapse was gradual over a prolonged *period, suggesting gradual pooling of blood in dependent* parts of the body together with incomplete compensatory constriction in regions where such reactions ordinarily take place In contrast, spontaneous syncope before administration of the drug was evident only 30-90 seconds before syncope, suggesting a sudden "break" in compensation—probably rapid dilatation of previously constricted vessels

The authors feel that intravenously administered meperidine is reasonably safe in normal individuals.

[The authors make the pertinent point that the drug must be injected slowly intravenously in order to avoid hypotension. Unfortunately with increasing use of meperidine (demerol®) intravenously as an adjunct to *nitrous oxide anesthesia there is increasing tendency to inject relatively* large doses rapidly with resultant significant hypotension even when the patient is in supine horizontal position.—Ed.]

Comparison of Effects of Morphine and Barbital on Volume Distribution of Potassium was made by Russell A. Huggins, Richard A. Seibert and Alpha R Bryan[3] (Baylor Univ) Although volume distribution of potassium in dogs anesthetized with sodium pento-barbital or with morphine-sulfate falls within the same range, several significant differences between the two groups were found (table)

With morphinized dogs, the average number of cubic centimeters per kilogram KCl that could be infused is significantly less less potassium was taken up by tissues the P wave disappeared at a lower plasma potassium level, and for volume distributions equal to those in barbitalized dogs infusion had to continue until auricoventricular block occurred. As death from potassium is cardiac, it follows that morphine must increase susceptibility of the heart to potassium ions

(3) Am. J Physiol. 168 32-36 January 1952.

A Comparison of Effects of Sodium Barbital and Morphine Sulfate on Average Values and Standard Deviations for Volume Distributions of Potassium

Drug	No	Weight Kg.		Initial K Level, Mg. %		Volume Distribution											
						60 Min			90 Min			120 Min			Total		
		Av	σ	Av	σ	No. Det	Av	σ	No. Det.	Av	σ	No. Det.	Av	σ	No. Det.	Av	σ
Barbital	28	9 7	6.11	15.7	1 99	31	97 9	18.5	9	108	20.8	9	114	26.3	49	103	21.5
Morphine	22	10.1	10.2	14 0	8.7	22	92.0	22.8	22	98	15.9	22	101	27 4	22	95	21.5
Standard difference between means							5.9			7 7			10.5			10.7	

When the vagi are cut in the morphinized dog, the P wave does not become intermittent adequate volumes of distribution are obtained if infusion is stopped when the P wave disappears, plasma potassium level is higher and more can be infused. State of tonus of the vagus is therefore important in controlling response of the heart to potassium. One explanation given is that the potassium ion may increase sensitivity of tissues to acetylcholine

Narcotics in Preanesthetic Medication Controlled Study was carried out on 558 patients undergoing anesthesia with ether, cyclopropane or thiopental sodium by Ellis N Cohen and Henry K. Beecher[4] (Harvard Med School) Three premedication solutions were prepared so that each 2 cc. volume contained (1) 15 mg morphine sulfate and 0 6 mg atropine sulfate (2) 90 mg pentobarbital sodium and 0 6 mg atropine sulfate, or (3) 0 6 mg atropine sulfate These were administered subcutaneously on the basis of 2 cc solution/70 kg body weight, usually 40-80 minutes before induction of anesthesia All agents were administered as "unknowns" and their effects characterized without knowledge of which one had been given

Average induction of anesthesia was not influenced by premedication with either morphine or pentobarbital The time required for insertion of the endotracheal tube was the same with all three solutions In addition, 47% of the time the anesthetists were unaware of presence of morphine in the premedicating solution Moreover they mistakenly thought 34% of the atropine control group had been premedicated with morphine, when the patients were evaluated independently of the characteristic eye signs Depth of anesthesia as indicated by venous blood levels of cyclopropane and ether and observations of milligrams of thiopental sodium required/minute showed no important and few significant differences with the three premedicating solutions Blood oxygen saturation and carbon dioxide elimination were satisfactory in the patients studied

Preoperative neutral questioning of the patients showed that morphine was slightly more effective (6%) than atropine alone in reducing preoperative excitement and also in producing a sleepy state preanesthetically Likewise there seemed to be a little less excitement under morphine than

(4) J A. M. A. 147:1664 1668 Dec. 22 1951

under the barbiturate, as judged by the patients' statements, this, however, was not evident to the anesthetist. The patients were also questioned on the first postoperative day There was little difference in power of the premedicating solutions used to prepare the patient for the anesthetic experience, as judged by his recall of discomfort There also was no difference in the patients ability to recall details (both spontaneous and suggested) of preanesthetic experience while under the three premedicating solutions Apparently they were equally satisfied with the solutions.

Unless pain is present, there is no need for a narcotic in preanesthetic medication. Its function can be adequately fulfilled by a small dose (90 mg) of pentobarbital sodium. There are fewer hazards associated with administration of this agent than with that of the commonly used narcotics

[It is common knowledge that morphine and other narcotics are inefficient drugs for the control of apprehension unless the apprehension is evoked by pain. There can be no denying that a barbiturate is a more effective hypnotic. It is unfortunate that the study did not include observations on the effectiveness of scopolamine as a premedicating agent. In view of the host of factors which significantly influence isolated blood samples of concentrations of anesthetic agents (which factors were not well controlled in this study) it is difficult to agree with the conclusion that the narcotics are in ffective in reducing the concentration of anesthetic required. It is exceed ngly difficult to understand why morphine did not significantly reduce the spiratory rate.—Ed.]

N Allyl Normorphine in Treatment of Morphine or Demol* Narcosis. James E Eckenhoff, John D Elder, Jr., and nton D King[5] (Univ of Pennsylvania) administered the ng intravenously to patients after minor surgery during which anesthesia was maintained with nitrous oxide oxygen and morphine or demerol.* Largest total dose of morphine was 90 mg and of demerol* 600 mg given within two hours or less. Controls were given n allyl normorphine alone

In the controls, n allyl normorphine acted as a depressant to respiration and circulation. In the experimental subjects it effected a dramatic response in counteracting the respiratory depression produced by morphine and demerol.* Respiratory rate was doubled or tripled throughout the observation period minute volume was initially increased up to 250% and then tapered off though remaining above the depressed level Second injections of n allyl normorphine were less effective than the first, and third injections were

(5) Am. J M. Sc. 223 191 197 February 1952.

ineffective Heart rate was slowed. There was no effect on *blood pressure unless it was depressed by the opiate, when* the antagonist caused a rise There was evidence of some awakening produced by n-allyl normorphine, but it was not remarkable

N-allyl normorphine was ineffective in combating depression produced by pentothal,* cyclopropane or ethyl ether Animal experiments suggest that it should be equally effective against depression produced by codeine, dilaudid,* methadone and metopon as that produced by morphine or demerol.*

Therapeutically, the drug appears to be of clinical value, particularly for mild or moderate depression due to opiates. The value of this antagonist in treating an overwhelming depression due to opiates is unknown, since repeated doses had a decreasing effect and there was a suggestion that they might cause further depression The authors suggest its use in treatment of the circulatory collapse that is sometimes seen after administration of morphine and demerol,* particularly in elderly patients, and to stimulate an overly depressed mother and baby just before delivery

[It is hoped that the availability of such a potent antidote will not breed carelessness in the use of narcotics.—Ed.]

Influence of Analgesics, Dromoran,* Nisentil* and Morphine on Pain Thresholds in Man were studied by Robert E. Lee and Carl C Pfeiffer[7] (Univ of Illinois) in 10 trained subjects with the warm wire algesimeter and the tooth algesimeter The warm wire algesimeter consisted of a Nichrome resistance wire (crimped to provide a tip for application of the stimulus) in series with a milliammeter a rheostat and a source of electrical current The tooth algesimeter provided an induced intermittent current as a secondary coil was moved toward a rotating primary coil.

To prevent confusion of touch with slight pain, the five spots on the forehead to be used for the test were touched with a cool wire the warm wire was then applied to the same five spots After the subject had been touched five times with the warm wire he reported the number of painful stimuli he had perceived The current was decreased until only three and finally two or less painful stimuli were perceived with five applications of the wire The forehead

(7) J Appl. Physiol. 4 193-198 September 1951

pain threshold was graphically computed on the basis of 2.5 painful stimuli out of five applications. With the tooth algesimeter the end point was the perception of true pain. Presumably equivalent analgesic doses were given morphine 20 mg., nisentil* 30 mg (20 mg in two subjects) and dromoran* 3 mg The pain threshold alteration produced by these agents was compared in each individual with that produced by a placebo

Morphine significantly raised the forehead pain threshold at 60 and 90 minute intervals and the tooth pain threshold at the 30, 60 and 90 minute intervals. Dromoran* significantly elevated the forehead pain threshold at the 60 and 90 minute intervals and the tooth pain threshold at the 90 minute interval. The differences between the alterations of the forehead and tooth pain thresholds produced by dromoran* and morphine were not significant Nisentil* did not significantly elevate the forehead pain threshold, but it raised the tooth pain threshold at the 90 minute interval. Failure of 20-30 mg nisentil* to raise the pain threshold in man is not in accord with previous findings, however, variability of response in the radiant heat algesimeter studies with nisentil* is thought to be the result of inadequate dosage Further experiments with 40 mg doses of nisentil* are suggested using the warm wire algesimeter which provides graded painful stimuli easy to apply and not disagreeable for subjects, with an instrument that is small, portable and inexpensive

Dramamine* Preanesthetic Medication. B W Zoffer and P H. Sechzer[6] (New York City) studied 150 consecutive adults coming to surgery They were grouped (50 each) in sequence according to operative schedule group I, 100 mg dramamine* orally at least one hour before operation,

TABLE I.—Incidence of Various Types of Reactions

Type of Reaction	Group I	Group II	Group III
Emesis, retching, nausea	0	0	1
Emesis, malaise, nausea	0	1	0
Emesis, nausea	1	3	2
Dizziness	0	1	0
Emesis	3	2	2
Retching	1	2	0
Nausea	2	0	1
	7 (14%)	9 (18%)	6 (12%)

(6) New York J Med. 52 725 Mar. 15 1952.

group II, 100 mg dramamine* orally an hour before surgery and 25 mg intramuscularly four hours after, group III, no dramamine* at any time

Table 1 lists incidence of various types of reaction for

TABLE 2.—INCIDENCE OF REACTIONS AGAINST METHOD OF ADMINISTRATION OF ANESTHESIA

Method	Group I		Group II		Group III	
	Reactions	Total Cases	Reactions	Total Cases	Reactions	Total Cases
Spinal	0	9	0	6	2	10
Inhalation	2	12	3	13	0	11
Intravenous	0	7	1	7	0	2
Regional and local	0	1	0	2	0	2
Combinations	5	21	5	22	4	25
Total	7	50	9	50	6	50

each group Table 2 correlates incidence of reaction against method of administration of anesthesia for each group studied Dramamine* administration did not significantly affect incidence of nausea retching and vomiting associated with clinical anesthesia

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INHALATION ANESTHESIA

Concentrations of Oxygen, Nitrous Oxide, Nitrogen and Ether and Their Correlation with Certain Physiologic Variables during Surgical Anesthesia in Man. Roger W Ridley, Albert Faulconer, Jr., and John E Osborn[8] (Mayo Clinic) studied 10 patients by means of an acoustic gas analyzer and other instruments

Average ether concentration at the time the peritoneum was opened was 11.6 vol. %, range being 7 17 Average concentration when it was closed was 7 3 vol. % (2 7 12 8) *Average of the highest values for the 10 patients was* 17 2 vol. % (11.7 25.2) Many factors influence concentration of ether vapor delivered to the patient The most important is the ether dial setting It was apparent that changes in the dial are quickly and substantially reflected by changes in ether concentration delivered to the patient However concentration cannot be accurately estimated from the dial.

(8) Anesthesiology 12 276 292 May 1951

In general, oxygen and nitrous oxide bore a reciprocal relation to each other In all patients the latter was used as an induction agent. In two, pure nitrous oxide was administered for a short period at the beginning of induction During induction there was moderate to severe fall in percentage oxygen saturation of arterial blood in 8 of the 10 patients it was below 80% in 4 During maintenance anesthesia there was a significant drop in the oximeter reading in only three patients Respiratory rate was slowest at the beginning of anesthesia being 8-16/minute Maximal rates were 48-86 With the continuous type of recording used, it is possible to detect very fast rates which may be present for only a short time and which the anesthetist may miss entirely During maintenance anesthesia the rate remained rapid between 30 and 50 In only two patients did it fall below 30 During induction and as depth of anesthesia progressed the rate consistently increased Maximal respiratory rates were observed during planes three and four or just before entering or after emerging from stage four anesthesia Changes in respiratory amplitude were often observed during anesthesia and the cause was not always clear During induction amplitude usually became less During maintenance anesthesia it was usually less than at the beginning of anesthesia There was no definite correlation of respiratory amplitude with respiratory rate, and one was observed to change without alteration in the other The most constant factor correlated with low amplitude was deep anesthesia

Heart rate was recorded continuously In the waking state the interval between heart beats varies significantly there is often as much as 50% variation in rate within a minute Shortly after induction of anesthesia this normal variation of the heart rate was greatly reduced and in many patients almost entirely obliterated This observation was made in all 10 patients within 20 minutes after beginning of anesthesia In several, a striking rise in heart rate was observed, which was probably caused by anoxia

Metabolic Effects of Anesthesia in Man V Comparison of Effects of Ether and Cyclopropane Anesthesia on Abnormal Liver in patients operated on to relieve portal hypertension and bleeding esophageal varices was made by Arthur B French, Theodore P Barss, Chester S. Fairlie Armand

L Bengle, Jr, Chester M. Jones, Robert R. Linton and Henry K. Beecher[9] (*Harvard Med. School*) Serial liver function tests (bromsulfalein retention, serum bilirubin, prothrombin time, urine urobilinogen, serum alkaline phosphatase) were performed preoperatively and 1, 3, 5 and 10 days after operation. Sixteen gastrectomy patients with no history or clinical evidence of liver disease served as normal controls. Twenty two interval cholecystectomies provided a common operation with likelihood of concurrent liver disease Thirty five operations for relief of portal hypertension with bleeding esophageal varices formed a group with demonstrable liver disease

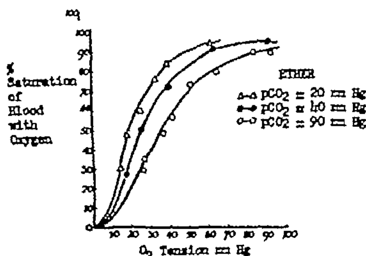
Postoperative abnormalities in liver function tests corresponded to type of operation and degree of preoperative liver disease After gastrectomy almost every patient showed bromsulfalein retention ranging up to 28% After cholecystectomy, bromsulfalein retention was greater and, particularly after common duct exploration more prolonged, with peaks as high as 64% With these operations, abnormalities, though slight, appeared in other liver function tests in 50% After shunt operations, extensive changes occurred in all liver function tests

Age, duration of operation or anesthesia did not appear to affect the degree or duration of postoperative liver function test abnormalities No significant difference was found between ether and cyclopropane in their effects on liver function tests

Oxygen Dissociation Curves of Whole Blood in Presence of Anesthetic Gases F J Prime[1] equilibrated samples in tonometers with six gas mixtures containing varying quantities of oxygen, suitable tension of carbon dioxide and the anesthetic gas under consideration. In the case of ether, nitrogen saturated with ether vapor was added to the oxygen and carbon dioxide to bring the mixture to atmospheric pressure After equilibration at 38 C the blood and the gas in contact with it were analyzed for oxygen and carbon dioxide From the results, sets of three curves were drawn for the control mixture and each of the three anesthetic agents used (Figs. 184 and 185) Each curve represented the mean of four determinations

(9) Ann. Surg 135 145 163 February 1952
(1) Brit. J Anaesth. 23 171 179 July 1951

No shift was apparent in the positions of the curves in comparison with the control, although allowance must be made for the margin of experimental error which was much greater than 5% Nevertheless, it could be concluded that



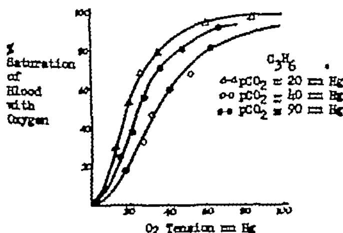


Fig. 184 (top).—Oxygen dissociation curves of whole blood equilibrated with oxygen and nitrogen saturated with ether vapor in presence of fixed amount of carbon dioxide.

Fig. 185 (bottom).—Oxygen dissociation curves of whole blood equilibrated with oxygen and cyclopropane in presence of fixed amounts of carbon dioxide.

(Courtesy of Prime, F J Brit. J Anaesth. 23 171-178 July 1951.)

the anesthetic gases had no effect on the oxygen dissociation curve of blood that was physiologically significant.

Renal and Hepatic Blood Flow, Glomerular Filtration Rate and Urinary Output of Electrolytes during Cyclopropane, Ether and Thiopental Anesthesia, Operation and Immediate Postoperative Period. Measurements of glomerular

filtration rate (inulin clearance), urinary sodium, potassium and chloride excretion renal blood flow (sodium para aminohippurate clearance) and estimated hepatic blood flow (bromsulfalein method) were made by D V Habif, E M Papper, H F Fitzpatrick, P Lowrance, C McC. Smythe and S E Bradley[2] (Columbia Univ) in 34 subjects before and during action of meperidine cyclopropane, ether or thiopental anesthesia major surgical procedures and the immediate postoperative period

Invariably meperidine (100 mg given subcutaneously to seven subjects and 50 mg to one) greatly depressed urine flow and excretion of electrolytes. Urinary concentration of the electrolytes usually increased Glomerular filtration and renal plasma flow decreased due to intrarenal vasoconstriction.

General anesthesia with cyclopropane, ether or thiopental evoked a much more striking vasoconstrictive response in both the liver and kidney in association with a fall in filtration, urinary concentration and excretion of electrolytes, and urine flow As a rule output of electrolytes and water decreased more than filtration, indicating relative augmentation in renal tubular reabsorption Operation had little additional effect. All values returned to or almost to control levels shortly after termination of anesthesia, which suggests that postoperative retention of water and salt may be due to tubular dysfunction.

Effect of Diphenyl Hydantoin (Dilantin®) on Ether and Pentobarbital (Nembutal®) Narcosis was studied by A. van Harreveld R J Foster and G D Fasman[3] (California Inst. of Technology) Animals were made spinal by ligating the dura at the tenth to the twelfth thoracic vertebrae Dilantin® and nembutal® were injected intra arterially in order to dilute them in the blood of the circulation before they reached the heart, and ether was given by inhalation

Minimal ether concentration in the blood necessary to narcotize knee jerk was determined at 10-15 minute intervals. In two experiments, such determinations made over two hours showed that this concentration has a tendency to increase slowly and gradually with time The first two determinations made after injection of 50 mg dilantin®/kg

(2) Surgery 10 241 255 July 1951
(3) Am. J Physiol. 166 718 722 September 1951

body weight gave values about 40% lower than the control ones. After this, the concentration necessary to suppress knee jerk increased again to reach the original level after about an hour The greatest depression of the concentration was not reached immediately after injection of dilantin® but 20-30 minutes later It was surprising that the effect of dilantin® on the narcotizing ether concentration was of relatively short duration (not over 90 minutes) Mean decrease of the concentration to narcotize knee jerk due to administration of dilantin® was 44 ± 2% Although dilantin® given alone has little effect on spinal reflex activity, it does potentiate the narcotic effect of ether This supports the thesis that the depolarizing effects of ether and dilantin® are additive and that depolarization is an important factor in the narcotic effect of ether on central conduction.

Pentobarbital was administered until knee jerk was all but suppressed Usually 65-80 mg/kg produced this effect In two experiments, knee jerk was checked every five minutes for two hours after pentobarbital was administered During this time a slight and gradual increase was observed Slow injection of 50 mg dilantin® had in general no immediate effect on height of knee jerk. However, a few minutes after injection the reflex contractions of the quadriceps muscle usually increased noticeably During the next 30 minutes the reflex contractions became either larger or returned to the original height of contraction. Doubling or even trebling the standard dose of 50 mg dilantin®/kg produced the same effect on the deeply narcotized knee jerk In none of the nine experiments was there evidence of potentiation of pentobarbital narcosis by dilantin® Depolarization seems of little importance for the narcotic effect of pentobarbital, since even the combined depolarizing action of this compound and of dilantin® are insufficient to depress knee jerk

Ventricular Fibrillation Following Rapid Fall in Alveolar Carbon Dioxide Concentration was studied by E B Brown, Jr., and Fletcher Miller[4] (Univ of Minnesota)

METHOD—Dogs were anesthetized with 30 mg/kg pentothal® sodium given intravenously Tracheotomy was done and the dog connected in open system to a 120 L. spirometer containing 30% carbon dioxide in oxygen and weighted so as to keep a 5 L. rubber anesthesia bag interposed between spirometer and tracheotomy tube,

(4) Am J Physiol. 169 56-60 April, 195_

in dosages of 10-60 mg/kg body weight. Subsequently, the individually standardized doses of epinephrine were injected. Seven of the eight animals exhibited ventricular tachycardia and two died of ventricular fibrillation.

In four additional experiments, 1 Gm. procaine amide (60-140 mg/kg) was given intravenously 15-30 minutes before induction. After injection the normal ECG complex showed pronounced depression of the RS-T segment and increased amplitude of the T wave. In the animals which received larger dosages, bundle branch block and ventricular tachycardia were observed. Equilibration in deep surgical anesthesia with cyclopropane was then achieved. In the first animal, when the standard dose of epinephrine was injected, ventricular tachycardia occurred and was immediately converted to ventricular fibrillation. In the other three an injection was made containing 5 gammas less of epinephrine than the individually standardized dose, ventricular tachycardia occurred which was of longer duration than had been present after the control injections of larger amounts of epinephrine.

Electrocardiographic tracings were made of 43 gynecologic patients anesthetized with cyclopropane. As premedication, 24 were given procaine amide orally (1.0 Gm. one hour before induction of anesthesia), intravenously during anesthesia or by a combination of both routes with a maximal dosage of 2.0 Gm. Those patients who received procaine amide orally were also given scopolamine (0.2 or 0.3 mg) about half an hour before induction of anesthesia. All others received scopolamine or a morphine-scopolamine combination. Average age was about 60 and age distribution in the controls was similar to that of the group which was given procaine amide. Premature ventricular contractions occurred in 14 and ventricular tachycardia was observed in 14 of the 24 patients who received procaine amide. This incidence of ventricular irregularities was not significantly different from that of the control group.

Procaine Amide for Prophylaxis and Therapy of Cardiac Arrhythmias Occurring during Thoracic Surgery. Samuel L. Joseph, Martin Helrich, Herbert J. Kayden, Louis R. Orkin and E. A. Rovenstine[7] (New York Univ.) administered the drug to 22 patients. A control series consisted of 25 patients

(7) Surg., Gynec. & Obst. 93:75-86, July 1951.

In most, surgery was intrathoracic Cyclopropane was the sole anesthetic agent used for intubation and maintenance. Procaine amide was administered orally, 1 0-2 0 Gm. one to two hours before induction. During thoracotomy (usually 30-40 minutes) an additional 1.0 Gm. was administered intravenously in divided doses Additional doses were administered intravenously during the subsequent maintenance period.

Electrocardiographic tracings were taken so as to coincide with definite anesthesiologic and surgical events and procedures Thus the tracings were relatable to them. Over all total incidence of relatable arrhythmias in the experimental series was half that in the control. Over-all incidence of relatable ventricular arrhythmias in the experimental series was a third that in the control. Total incidence of arrhythmias in the experimental series was equalled by incidence of relatable ventricular arrhythmias alone in the control series These same differences were present throughout the phases of anesthesia. Arrhythmias which were not relatable to definite events and procedures were comparatively rare the same over all differences between control and experimental series noted in the comparison of relatable tracings were manifested. Inadequate ventilation appeared to be associated with onset of ventricular arrhythmias more often than any other single factor Surgical procedures classically implicated in initiation of arrhythmias were not often found to be associated with them.

The therapeutic effectiveness of procaine amide in ventricular arrhythmias was tested in 17 patients 7 of these were in the experimental prophylactic series Intravenous injections were made 29 times, with reversion to normal sinus rhythm 25 times in an average of 1.3 minutes (range 0-8 minutes) after the end of injection. The four ventricular arrhythmias which persisted were reverted to normal sinus rhythm by a second injection. In all cases procaine amide was not used until other measures, short of administration of a drug had been unsuccessful.

Intravenous prophylaxis alone is recommended as being more dependable in the preoperative patient It is suggested that 500 mg be administered over three to five minutes just before induction This may be followed by a like quantity shortly after induction of anesthesia before laryngoscopy

and intubation, administered in two to four minutes. For the additional 1.0 Gm. injected during thoracotomy, divided doses, regularly spaced during the interval required for this part of the surgical procedure, are recommended. Procaine amide was uniformly useful in treatment of ventricular arrhythmias. Because of the transient hypotension occasionally produced by moderate doses injected intravenously, an initial scouting dose of 200 mg given in 60 seconds is recommended for therapy This may be followed, if required and if pronounced hypotension does not occur, by 500 mg doses given in two to four minutes.

[It is evident, at least, that the "protection" afforded by procaine amide is not so outstanding that there is no debate as to its effectiveness.—Ed.]

Comparison of Effect of Pituitrin,* Pitocin* and Ergonovine on Cardiac Rhythm during Cyclopropane Anesthesia for Parturition Lucien E Morris, Madeline J Thornton and John W Harris[8] (Univ of Wisconsin) made electrocardiograms of 103 obstetric patients before and after intramuscular administration of 1 cc. pituitrin,* pitocin* or ergonovine during cyclopropane anesthesia. Evidence in the statistical evaluation of the observed cardiac irregularities did not substantiate the hypothesis of specific incompatibility between pituitrin* and cyclopropane

Records of 18 of 21 patients with irregularities of ventricular origin showed obstruction and consequent hypoxia, which may have been present but less pronounced in some of the other eight. Generalized hypoxia is a frequent sequel to pituitrin* because of retching or active vomiting and consequent mechanical interference with respiratory exchange It may therefore be wise to avoid administration of a substance which may increase incidence of obstruction and generalized hypoxia and also cause coronary constriction and myocardial hypoxia.

To discount the effect of obstruction, results were screened by deleting all cases of obstruction noted after administration of the oxytocic In these selected groups only one irregularity occurred among the 12 patients who received pitocin,* whereas of 44 in the pituitrin* group 26 exhibited irregularities. This suggests that pituitrin* be avoided in favor of a potentially less hazardous oxytocic

(8) Am. J Obst. & Gynec. 63 171 174 January 1952.

Relation of Intubation to Postoperative Respiratory Complications N A. Gillespie[9] (Univ of Wisconsin) selected from among nearly 55,000 anesthetized patients two groups that were truly comparable (cholecystectomy, "physical state 2," two-and fro ether anesthesia and absence of respiratory disease before operation) They consisted of 148 patients who had been intubated and 37 who had not. In the intubated group 9 patients (6 1%) had major respiratory complications and 12 (8 1%) minor Among the 37 nonintubated patients there was one (2.7%) respiratory death, three (8 1%) major and seven (18 9%) minor complications. The "fourfold table" thus became

	Intubated	Not Intubated
No. showing complications	21 (a)	10 (c)
No. free from complications	127 (b)	27 (d)

The following formula was then worked out

$$\chi^2 = \frac{(ad-bc)^2 \; (a+b+c+d)}{(a+b) \; (c+d) \; (a+c) \; (b+d)}$$

If the figures from the table are substituted, χ^2 equals 3 5 Reference to the χ^2 table shows that in this instance P equals 0 06 Statisticians usually regard P equaling 0 05 as the borderline of statistical significance thus, these results, although tending to show that in these particular groups intubated patients had less postoperative respiratory complications, were therefore just outside the conventional limit of statistical significance When the same formula is applied to the major complications χ^2 equals 0.20 and P equals 0 65, which means that the difference between the two groups certainly was not statistically significant.

Some Anatomic Considerations of Infant Larynx Influencing Endotracheal Anesthesia are discussed by James E. Eckenhoff[1] (Univ of Pennsylvania) These structures differ in many respects from those of the adult Failure to recognize such variations can lead to laryngeal trauma and edema.

In the infant the larynx is located more cephalad than in the adult. With advancing age the structure moves lower in the neck so that in the adult the rima glottidis is usually

(9) Anesthesia 6 206-210 October 1951
(1) Anesthesiology 12 401-410 July 1951

opposite the level of the interspace of the fourth and fifth cervical vertebrae (Fig 186)

The epiglottis of the infant is a considerably different structure from that of the adult, it is relatively longer, stiff and U or V shaped, whereas in the adult it is more flexible

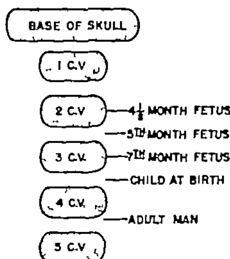


Fig. 186 —Relation of aperture of larynx to base of skull and vertebral column. (Courtesy of Eckenhoff J E. Anesthesiology 12:401-410 July 1951)

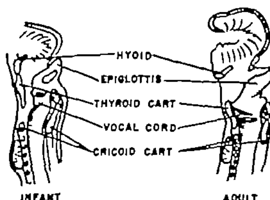


Fig 187 —Infant and adult larynx in sagittal section. (Courtesy of Eckenhoff J E. Anesthesiology 12 401-410 July 1951)

and tends to be flat. It also assumes a different angle in relation to the anterior pharyngeal wall, approximating a 45 degree angle from it. The epiglottis of the adult lies closer to the base of the tongue

As indicated in Table 1, with advancing age, increase in length of the vocal cord is accomplished almost entirely in the ligamentous portion In the infant, about half the vocal

cord is cartilaginous Since the vocal process of the arytenoid cartilage is inclined inferiorly and medially (down the trachea and inward), the vocal cord is concave (Fig 187) In the adult, since the cartilaginous portion is relatively small, concavity is not significant With growth, as the superior aspect of the thyroid cartilage inclines forward, the anterior attachment of the vocal cords also moves forward, tending to straighten them.

It is usually assumed that the rima glottidis is the narrowest point in the upper respiratory tract Although this is most often true in the adult, it may not be true in the

TABLE 1.—Relation of Ligamentous Portion of Vocal Cord to Internal Anteroposterior Diameter of Larynx*

Sex	Age	Internal A P Diam. of Larynx, Mm	Length of Ligamentous Portion of Vocal Cord Mm.
F	3 da.	7	3
M	6 da.	8	4.5
F	14 da.	7.5	4
M	5 wk.	6.5	4
M	2 mo	8	5
F	3 mo.	7.5	4.5
M	9 mo.	9	6
M	1 yr	8.5	5.5
F	2½ yr	8	5
F	5 yr	10	7.5
M	8½ yr.	10.5	7
F	15 yr	14	9.5
M	19 yr	23	17

*After Negus, V E. Mechanism of Larynx (St. Louis: C. V Mosby Company 1930)

infant or small child The narrowest point may be at the level of the cricoid cartilage (Table 2)

Some bronchologists consider the columnar epithelium of the larynx of the infant or child to be physiologically similar to the erectile epithelium in the lower turbinate Reference to Table 3 will indicate the effect uniform edema of 1 mm. will have on reducing the cross-sectional area of the laryngeal cavity at the level of the cricoid ring

In the infant the laryngoscope blade may have to be passed perpendicularly downward, with the head in neutral position, to expose the epiglottis. At this angle elevation of the epiglottis may not be accomplished readily The bulky tongue may be an additional hindrance If the laryngoscope blade is passed beneath the epiglottis into the post

TABLE 2.—INTERNAL CIRCUMFERENCE OF LARYNX AND TRACHEA IN CHILDREN*

Age	Glottis, Mm	Cricoid Ring Mm	Trachea, Mm.
4 mo.	23-26	20	22-25
6 mo	26	20	24
7 mo.	26	22	25
8 mo	24	21	24
10 mo	25	22	26
13 mo.	25	22	26
17 mo	26	22	25
23 mo.	30	23	28
2 yr	30	24	30
3 yr	27	23	27
4 yr	30-33	26	30-33
5 yr	30	26	33
7½ yr	42	28	33
10 yr	39	30	39
14 yr	42	36	42

After Bayeux: Presse méd. 20 1 1897

TABLE 3.—EFFECT OF 1 MM. UNIFORM EDEMA ON REDUCING CROSS-SECTIONAL AREA OF LARYNX AT CRICOID RING

Diameter at Cricoid Ring, Mm	Area, Mm.²	Area if 1 Mm Uniform Edema, Mm.	Decrease in Area, %
4	12.6	3.14	75
5	19.6	7.1	64
6	28.3	12.6	55.5
7	38.6	19.6	49.2
8	50.2	28.3	43.6
9	63.3	38.6	39.0
10	78.6	50.2	36.2
12	113.0	78.6	30.4
14	154.0	113.0	26.7
16	202.0	154.0	23.4
20	314.1	259.0	19.0

cricoidal space, then slowly withdrawn until the arytenoid cartilages appear into view, elevation of the epiglottis may be facilitated. Elevation of the tip of the blade and slight forward movement will then usually result in good exposure of the vocal cords

Passage of the endotracheal tube between the cords may be impeded as the concavity and slightly inferior anterior attachment of the cords may offer points for impingement of the tip of a curved tube In blind tracheal intubation slight flexion of the head may permit easy advancement of the tube This causes the tube to move posteriorly, thus

clearing the point of obstruction In visual intubations in which the tube cannot be advanced, slight depression of the tip of the laryngoscope blade, pushing the tube posteriorly, allows it to be advanced. From the data it is evident that in an infant an endotracheal tube which will pass between the cords with ease may not go through the cricoid ring

Reflex Circulatory Responses to Direct Laryngoscopy and Tracheal Intubation Performed during General Anesthesia. The effects of laryngoscopy and tracheal intubation on the cardiovascular system can be easily overlooked during clinical anesthesia. The anesthetist may become so engrossed in the technical aspects of intubation that he has little opportunity to note any abnormal circulatory reaction B D King L C Harris, Jr., F E Greifenstein, J D Elder, Jr., and R D Dripps[2] (Univ of Pennsylvania) studied these effects in 46 patients All had received morphine or meperidine plus atropine or scopolamine for preanesthetic medication. An attempt was made to maintain the desired plane of anesthesia sufficiently long so that removal of the mask at the time of tracheal intubation would not cause rapid change in depth of anesthesia Laryngoscopy was usually completed less than 15 seconds after ventilation was discontinued. Coughing breath holding or straining at the time of intubation produce circulatory responses independent of those caused by instrumentation of the pharynx, larynx and trachea Therefore records obtained during such disturbing reflexes were excluded

When the epiglottis was elevated by direct laryngoscopy, systolic and diastolic blood pressure usually increased within five seconds On insertion of the tube into the trachea, blood pressure was further increased Average rise in systolic pressure in the 27 patients whose tracheas were intubated was 53 mm Hg and that in diastolic pressure, 34 mm. A plateau at or about this peak pressure was maintained for one or two minutes followed by gradual return to the prelaryngoscopic levels within five minutes. Cardiac rate was increased an average of 23 beats/minute in the 27 patients. In none did the rate become slower than the control. Laryngoscopy alone affected rate less consistently, for in only 19 of 32 patients was it increased significantly

(2) Anesthesiology 12 556-566 September 1951

one patient laryngoscopy resulted in slowing of the rate. In another, bradycardia occurred with passage of the endotracheal tube through the nose As anesthesia was deepened to second or third plane, changes in blood pressure and pulse rate incident to laryngoscopy and tracheal intubation became less prominent. Average increase in systolic blood pressure was only 16 mm. Hg, in diastolic pressure, 10 mm. Cardiac rate was increased an average of 13 beats/minute. Cardiac arrhythmia was not noted during laryngoscopy Abnormalities of rhythm developed in seven patients with tracheal intubation, six of whom were lightly anesthetized.

All circulatory responses appeared to be independent of anesthetic agents used and were unaltered by omission of curariform drugs. The most important factor appeared to be depth of anesthesia. The increases of pressure sometimes were of considerable magnitude, systolic pressure rises of 90 or more mm Hg were recorded in four patients It seems advisable, therefore, to use discretion in performing tracheal intubation during very light anesthesia Carbon dioxide retention and anoxia could be ruled out as a factor in production of the rise in blood pressure and pulse rate In an experiment designed to confirm this several patients were allowed to remain apneic for a period longer than that usually required for tracheal intubation. Changes in blood pressure and pulse rate were insignificant. When artificial ventilation was resumed and laryngoscopy accomplished later the typical pressor response appeared.

VENTILATION

Circulatory Effects of Raised Airway Pressure during Cyclopropane Anesthesia in Man Although the effects of increased intrapulmonary pressure on the circulation of normal, conscious man have been carefully studied, knowledge of the changes resulting from raised airway pressure in anesthetized man is virtually lacking In animals studied under general anesthesia, arterial pressure declined more in response to raised airway pressure when anesthesia was profound than when it was less deep Henry L Price Benton D King John D Elder Benjamin H. Libien and Robert

D Dripps[3] (Univ of Pennsylvania) therefore studied 12 patients under cyclopropane anesthesia

METHOD.—The effects of raised airway pressure were observed while the subject was conscious, after which anesthesia was induced. Depth of anesthesia was increased rapidly with cyclopropane, a cuffed endotracheal tube introduced, the cuff inflated and the airway pressure raised for the second time. In nine patients a catheter was

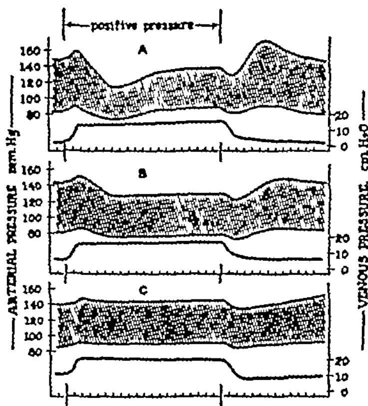


FIG. 188.—Effect of raised airway pressure on arterial and venous pressures of nine subjects. *A*, subjects conscious *B*, subjects lightly anesthetized *C*, subjects deeply anesthetized. (Courtesy of Price H. L. *et al.* J Clin. Invest. 30:1243-1249 November 1951)

introduced into the right atrium, superior vena cava, innominate vein or internal jugular vein

There was no consistent effect of cyclopropane anesthesia on arterial pressure or heart rate, but intrathoracic venous or right atrial pressure was increased consistently (average of 12.5 cm. water) A smaller rise was recorded during less profound anesthesia

In conscious persons, airway pressure of 22-25 cm. water caused (1) a sharp, small rise in systolic, diastolic an pulse pressure which lasted 1-2 seconds, (2) decrease

(3) J Clin. Invest. 30 1243-12

three pressures which became maximal in 6-10 seconds, and then (3) slow return toward control values (Fig 188) With release of airway pressure there was (4) a sharp, slight decrease in all values, followed by (5) an "overshoot" which reached a maximum in four to seven seconds In lightly anesthetized subjects there was no tendency for arterial pressure to return toward control values while airway pressure was elevated "Overshoot" was absent in five and minimal in four During deep anesthesia in no subject was pulse pressure depressed when airway pressure was raised. In two patients systolic and diastolic pressures decreased slightly Again, "overshoot" was absent. Reductions in systolic, diastolic and pulse pressures following increase in airway pressure were all greater in the conscious than the lightly anesthetized subjects, and were significantly greater in the latter than in deeply anesthetized ones.

Venous pressure rose abruptly as increased pressure was applied to the airways of conscious, lightly or deeply anesthetized subjects As raised airway pressure was maintained, it continued to rise slowly in the conscious subjects (arterial pressure tending to return toward control values phase 3) In lightly anesthetized subjects venous pressure rose slightly or not at all during the same period (arterial pressure showing no tendency to return toward control values) In deeply anesthetized subjects it did not rise or decreased slightly at this time

In conscious subjects airway pressures of 22-25 cm. water increased venous pressure to 11 15 cm., a "transmission" of 55% Anesthesia apparently affected "transmission," since the same increase in airway pressure resulted in a rise of 10-13 cm water in venous pressure during light anesthesia (45%) and of only 9 11 cm. during deep anesthesia (41%) Each of these values was significantly different from either of the others. Cyclopropane anesthesia, therefore, not only increased pressure in the intrathoracic veins and right atrium, but at the same time diminished "transmission" of raised airway pressure to these structures. In all patients in whom arterial pressure did not decrease in response to raised airway pressure, the rise in intrathoracic venous or right atrial pressure associated with anesthesia was greater than the pressure transmitted to these structures from the airway when the lungs were inflated under positive pressure

Device Producing Regulated Assisted Respiration II. Prevention of Hypoventilation and Mediastinal Motion during Intrathoracic Surgery Administration of "assisted" respiration by manual compression of the anesthesia bag during inspiration is widely used to improve pulmonary ventilation and to reduce motion within the open thorax. James V Maloney, Jr, William S Derrick and James L Whittenberger[4] (Boston) studied respiratory rate, tidal volume and minute volume in anesthetized patients whose respira-

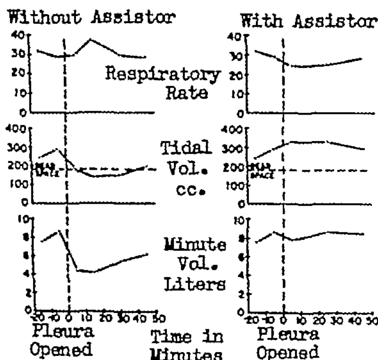


Fig. 189 —Lung ventilation during transthoracic surgery with mean values for six cases. Comparison with and without "assistor" Respiratory rate per minute. (Courtesy of Maloney J V., et al. Anesthesiology 13:23-32, January 1952.)

tion was being "assisted" and found inadequate pulmonary exchange (Fig 189) Therefore a means was sought to administer mechanically and automatically inspiratory assistance that would produce a more physiologic anesthesia.

An apparatus with a valve capable of responding to the first inspiratory air flow was constructed. The valve begins almost immediately to assist inspiratory effort by producing a high flow rate of gas at any pressure adjustable at 0-20 cm. water Respiratory assistance is given only while the patient is actively inspiring the valve closes when the air flow rate

(4) Anesthesiology 13:23-32, January 1952.

becomes slowest just before the end of inspiration. This apparatus may be used with any standard anesthesia machine and with any anesthetic agent, it includes a "ventigrator," a meter which continuously records measure of pulmonary ventilation.

Use of the ventigrator demonstrated that severe hypoventilation followed the opening of the pleura. Data in Figure 189 show that manually 'assisted" respiration gives a negative value for alveolar ventilation, indicating that tidal volume is below that necessary to wash out the estimated dead space of the tracheobronchial tree When the assisting machine was used, effective alveolar ventilation (equal to tidal volume minus dead space times respiratory rate) remained close to normal levels (4 0 L./minute in the resting adult)

Continuous lung inflation is often necessary to aid in delineation of lung segments in pulmonary decortication, and in lung inflation at the end of an operation with the assisting apparatus, it may be used without compromising pulmonary exchange Without the apparatus, continuous positive pressure decreased minute volume by 40% (in addition to the decrease in ventilation that had already occurred when the pleura was entered) There are several reasons for this effect of continuous inflation (1) It is mechanically more difficult for the intact lung to breathe against the resistance of a distended breathing bag (2) Continuous pressure causes a reflex slowing of the respiratory rate in many patients (3) Pendelluft, the paradoxical movement of gas from one lung to the other occurs

Hypoventilation and motion in the operative field are inseparable Vigorous diaphragmatic movement and the shifting mediastinum are expressions of the nervous system's dissatisfaction with the partial pressure of gases in the blood To avoid excessive motion in the operative field, adequate pulmonary exchange must be provided.

Observations on Inhibitory Respiratory Reflexes during Abdominal Surgery E B Reeve, E M. Nanson and F F Rundle[5] (London) studied over 50 patients Periods of apnea were common during upper abdominal operations performed under morphine thiopental-d tubocurarine anesthesia through anterior or anterolateral incisions, but they

(5) Clin. Sc. 10 65 27 February 1951

were rare during other abdominal operations. These periods were also noted in patients under other combinations of anesthetics and in conscious ones They were caused reflexly by pressure, tension and friction to the deep surfaces of the parietal peritoneum covering the upper abdominal wall and anterior diaphragm. The upper ligamentum teres was particularly sensitive The afferent paths were shown to be in the intercostal nerves in animals, therefore, this is also probably true for man

In rabbits and dogs the same reflex was demonstrated. Effective surgical stimuli were the same as those for man, but in the rabbit the receptor field was larger In the rabbit peritoneal stimulation caused immediate inhibition of inspiration and closure of the glottis. The glottis closed during, or at the height of, the last inspiration before respiratory inhibition The lungs were then held in inspiration, or the glottis was opened a little to permit a slow expiration. If, to prevent the glottal effect, the trachea was cannulated, on respiratory inhibition the lungs immediately assumed their usual or a somewhat exaggerated expiratory volume In the dog and rabbit, depression of the diaphragm, caused by pulls on it or on viscera attached to it, slowed or arrested respiration and increased functional residual air This reflex was abolished by section of both vagi in the neck and was probably the inflation Hering Breuer reflex. It was not seen in man, probably because sufficient force was not exerted on the diaphragm during operation.

The inhibitory respiratory reflex, by closing the glottis and stopping respirations, can prevent adequate aeration of the lungs and adequate flow of anesthetic gases. It is best abolished by local anesthetization of the parietal peritoneum During abdominal operation there was considerable variation in frequency and duration of inhibitory respiratory responses. Reflex variation implies that a proportion of patients will show an exaggerated response This is of surgical importance when the reflex is potentially harmful.

Intrapulmonary Mixing of Helium in Normal and Emphysematous Subjects. W A. Briscoe, M R Becklake and T F Rose[6] (Postgraduate Med. School) studied ventilation of the lungs in 16 normal subjects and 16 with bronchitis and emphysema. The method used was developed from that of

(6) Clin. Sc. 10 37-51 February 1951

McMichael for measuring lung volumes with a katharometer Apparent functional residual air was estimated after different periods of rebreathing from the spirometer

Normal subjects ventilated the lungs evenly, though some showed minor deviations (Fig 190) At each breath they introduced over 200 cc inspired air into the mixing spaces of the lungs. Emphysematous subjects introduced smaller quantities of inspired air into the mixing spaces of the lungs at each breath (Fig 191) When compared with "robot lungs," behavior of emphysematous lungs resembled that due

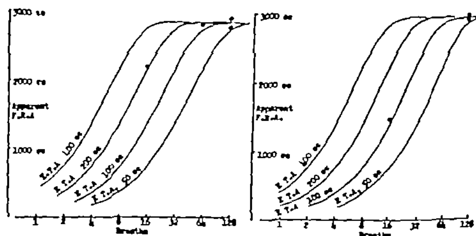


Fig. 190 (left) —Mixing curve of elderly normal subject.
Fig. 191 (right) —Mixing curve of emphysematous subject.
(Courtesy of Briscoe W A., et al Clin. Sc. 10 37-51 February 1951.)

to uneven ventilation rather than to increase in dead space or reduction in tidal air In almost all subjects observations suggested that a large part of the lungs was sufficiently poorly ventilated to reduce effective tidal air to less than 100 cc.

[These observations help to explain the difficulties associated with the use of inhalation anesthesia in emphysematous patients and point up the need for caution in using high concentrations of inhalation agents in attempts to hasten induction.—Ed.]

Oxygen Consumption and Anesthesia. Ralph Shackman, G I Graber and C Redwood[7] measured the oxygen consumption rates of 23 patients before and during operations performed under general anesthesia The disabilities for which the patients were to be operated on were not of the type expected to affect metabolism no patient had a thyroid

(7) Clin. Sc. 10 219 228 May 1951

disorder or was febrile All patients had been previously sedated with morphine and atropine or omnopon and scopolamine, and were in a fasting state. Anesthetic agents used were cyclopropane, nitrous oxide, pentothal® and curare, in various combinations.

Twenty patients showed decreased oxygen consumption under surgical anesthesia as compared to preanesthetic levels. Two others showed increases of 2.5 and 4 9%, whereas in the third oxygen consumption remained the same Average decrease was 22.0%, whereas average absolute decrease was 54 6 ml /minute This was highly significant.

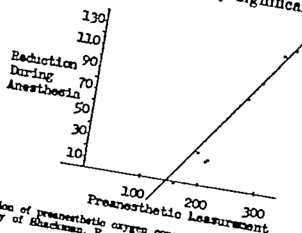


Fig. 192.—Relation of preanesthetic oxygen consumption to percentage fall during anesthesia. (Courtesy of Shackman, R., *et al.* Clin. Sc. 10:219 228 May 1951.)

When the individual readings of the preanesthetic rates were plotted against the respective absolute reductions of oxygen consumption during anesthesia, the points were clustered about a line (Fig 192) Slope and position of this regression line was $y = 0.702\ (x - 145)$ where y = reduction during anesthesia and x = consumption before anesthesia.

Despite previous sedation and fasting preanesthetic oxygen consumption rates were abnormally high in some patients and no doubt reflected their apprehension. Nevertheless, almost 40% had rates less than the corresponding basal levels of the Standard Table Twenty-one patients showed decreases under surgical anesthesia as compared to the basal values of the Standard Table. The remaining two showed increases of 1 8 and 11.3% Average decrease was 14.5% whereas average absolute decrease was 29 0 ml./minute This was highly significant

Chest Movements and Intercostal Muscles Of many efforts to analyze chest movement, none seems to have given complete satisfaction and the matter is still confused. W B Primrose[8] (Glasgow) believes this confusion to be the outgrowth of basing physiologic researches into chest movement problems on the anatomist's interpretation. An approach to the understanding of chest movements must begin with direct observation, uninfluenced by preconceptions which have never been able to demonstrate actual function.

Radical mastectomy has afforded excellent opportunities for close observation of the external intercostal muscles. They appeared to offer little resistance to the negative intrapleural pressure and did not appear to contract rhythmically when some of the fibers were accidentally cut. During some cerebellar operations it was further noted that cut ends of the reflected occipital muscles contract during inspiration This indicated that breathing, made difficult by proneness, could call into play any muscles that could exert any influence, however indirect on the chest, independent of any morphologic arrangement. It has also often been noticed that the physical effort required to give artificial respiration is out of all proportion to the effects produced, particularly in elderly subjects. From this it would appear that the chest tends to fixation and does not contribute greatly to breathing These observations led the author to observe directly the breathing muscles of dogs and rabbits and he found that the intercostal muscles actually play an insignificant part in breathing

In mammals an entirely new muscle, the diaphragm, has evolved to operate a new principle of respiration—active inspiration. Normally mammals have no equally strong act of expiration. Muscles that may be called into play to aid respiration are ordinarily left free for doing work under conscious impulse as in the lifting of weights.

It is obvious, then, that the notion of paralysis of the intercostals as a sign of deepening anesthesia does not exist in fact, as these muscles, even when tense do not act visibly with clear breathing The in sucking movement seen is phrenic in origin its diminution either is a sign of weaker action of the diaphragm as anesthesia deepens or is due to dilatation of the larger bronchi facilitating respiration. Fur

(8) Brit. J Anesth. 24:2-24 January 1952.

ther, the intercostals are entirely covered by much heavier muscles and are much too deeply situated to show possible activity of their own.

[These observations give cause for serious reflection upon the traditional concepts of chest movements during anesthesia.—Ed.]

Effect of Position and Artificial Ventilation on Excretion of Carbon Dioxide during Thoracic Surgery was investigated by Henry K. Beecher Thomas J Quinn, Jr., John P Bunker and Genesio L D'Alessandro[9] (Boston) Elimination of carbon dioxide in the prone position without assistance to respiration was as good during lobectomies and better during pneumonectomies than in the lateral position with bag squeezing or machine assistance to respiration During lobectomies, average rise in arterial pCO_2 was in the lateral position without assistance to respiration, from 33 mm. at the beginning to 67 mm Hg at the end of the procedure, in the lateral position with assistance from 44 to 48 mm. in the prone position (Overholt) without assistance from 46 to 51 mm. During pneumonectomies, average rise in pCO_2 was in the lateral position with assistance from 43 to 58 mm, in the lateral position without assistance, from 35 to 98 mm., in the prone position without assistance, from 41 to 47 mm Results obtained by manual squeezing of the anesthesia bag seemed better than those obtained by use of a machine

Although the prone and supine positions are most favorable for natural excretion of carbon dioxide, surgeons operating on the thorax need not select either They may be confident that simple squeezing of the bag by hand will protect the patient if they choose the lateral position.

Influence of Respiratory Gas Mixtures on Arterial Pressure and Vascular Reactivity in 'Normal and Hypertensive Dogs was studied by Irvine H Page and Frederick Olmsted[1] (Cleveland Clinic) Failure of arterial pressure to respond to pressor and depressor agents (vascular refractoriness) was elicited in normal dogs by inhalation of carbon dioxide-oxygen mixtures containing 15-60% CO_2 The refractoriness often disappeared within a few minutes after restoration of the animal to atmospheric air and its speed of onset varied with the concentration of CO_2 administered. Responses to epinephrine were most easily abolished, those to

(9) J Thoracic Surg. 22 135-143 August, 1951
(1) Circulation 3 801 819 June 1951.

nor-epinephrine less so and to angiotonin and barium chloride least. Drugs such as sodium azide, sodium nitroprusside and partially purified veratrum alkaloids showed greatly reduced depressor activities. Gas mixtures high in nitrogen, even to the point of asphyxia, failed to elicit phenomena characteristic of carbon dioxide-oxygen inhalation.

Tetraethylammonium chloride, given during a period of refractoriness, caused a large rise in arterial pressure, often followed by a fall. Responsiveness was partially restored but complete recovery occurred only when CO_2 was discontinued. Carotid sinus resection, vagotomy, adrenalectomy, thorough atropinization and section of spinal cord at the sixth cervical segment did not significantly influence development of refractoriness, preliminary autonomic ganglionic blockade with tetraethylammonium chloride gave partial protection against it. "Total" surgical sympathectomy alone entirely prevented its appearance, although it sensitized the dogs to the hypotensive action of CO_2 and blood pH fell to the same low levels in sympathectomized as in normal animals. Reappearance of reactivity following tetraethylammonium administration was not accompanied by rise in pH toward normal. Infusions of hydrochloric or lactic acids failed to elicit the low pH caused by CO_2 and did not reproduce the vascular phenomena characteristic of CO_2 inhalation.

Dogs with experimental renal hypertension responded normally to most vasoactive substances tested. Neurogenic hypertensive animals showed greatly augmented depressor responses to CO_2, azide and nitroprusside, and very slightly reduced pressor responses to epinephrine and nor-epinephrine. Refractoriness developed in renal hypertensive just as in normal animals. The sequence was somewhat different in neurogenic hypertensives in which at lower concentrations of CO_2, responsiveness usually increased; at higher concentrations, responsiveness became inhibited. Changes in blood pH were roughly the same for all groups.

Study of Anuria Occurring during Apnea under Diffusion Respiration in dogs was conducted by Frank A. Kopecky, Chalmers J. Rayburn, Richard W. Whitehead and William B. Draper[2] (Univ. of Colorado). Attention was paid to the role played by anhydremia and to the influence of the renal

(2) Am. J. Physiol. 168 131 137 January 1952.

nerves in production of anuria Four series of experiments, using five dogs each, were carried out. The controls had intact renal innervation and received no fluid intravenously The animals in the second series were similar but were given plazmoid* solution. In the third series no fluid was given intravenously, but unilateral renal nerve block (15 cc of a 0.1% solution of tetracaine) was done In the fourth series plazmoid* solution was administered as in the second, and the left renal innervation was blocked as in the third.

It was found that anuria occurs in dogs immediately after respiratory arrest brought about by an overdose of thiopental sodium under conditions permitting diffusion respiration (patent airway adequate circulation and denitrogenation) Onset is neither prevented nor delayed by vigorous administration of a plasma substitute The anuria is reversible, because with resumption of spontaneous respiration secretion of urine returns in fact, the volume is greater than before apnea

Onset of anuria is due wholly or in part, to impulses transmitted over the renal nerves, because when the innervation of one kidney has been blocked anuria is delayed in that kidney until the 25th minute of apnea Further, if a plasma substitute is given to eliminate the anhydremia which normally characterizes diffusion respiration, severe oliguria does not appear on the anesthetized side until the 45th minute of apnea The contralateral kidney (innervation intact) exhibits complete anuria shortly after cessation of respiratory movements.

Toxic doses of thiopental sodium and anoxemia have been ruled out as the mechanisms that exert the oliguric effect, This leaves hypercarbia as the probable cause.

[Additional evidence of the highly undesirable effects of carbon dioxide accumulation. Concentrations of carbon dioxide approaching these experimental levels go unrecognized in many clinical anesthetic situations.—Ed.]

BARBITURATES

Effects of Picrotoxin on Distribution and Excretion of C^{14} Labeled Pentobarbital. Using pentobarbital labeled with C^{14} at the 2-carbon atom, J B Kahn, Jr [3] (Univ of Chicago) studied tissue distribution and excretion of pento-

(3) Current Res. in Anesth. & Analg. 31 130-135 Mar. Apr 1952

barbital 2-C^{14} and its labeled breakdown products, tested effects of picrotoxin on this distribution and excretion and examined the specificity of the liquid liquid extraction procedure for isolation of unchanged pentobarbital from biologic fluids and tissues

The extraction procedure used for separating pentobarbital from tissues was found nonspecific, as considerable quantities of C^{14}-containing impurities appeared in pentobarbital extracts of brain, liver and urine This indicates that previous studies of distribution and excretion of barbiturates using this method must be re-evaluated.

Picrotoxin had no effect on distribution of either total C^{14} or pentobarbital-containing fraction in any tissue nor on total amount of C^{14} excreted in urine Eckenhoff's hypothesis that picrotoxin may act by displacement of barbiturates from their combination with brain tissue must therefore be discarded

Prolongation of Thiopental Anesthesia in Mouse by Premedication with Tetraethylthiuram Disulfide (Antabus®) is reported by Nicholas J Giarman, Ferdinand H. Flick and Joseph M. White[4] (Yale Univ) The anesthesia time in three groups of mice was determined for 30 mg thiopental/kg body weight given intravenously Criterion for recovery from anesthesia was return of the righting reflex. Group 1 was given no premedication, group 2 received 25 mg antabus® orally daily for three days and group 3 received the same antabus® premedication but injection of thiopental was immediately followed by administration of 0 1 mL ferroascorbin intravenously Mean duration of anesthesia was 4.7 minutes in the control group and 256.2 and 221.5 minutes in groups 2 and 3 Determinations of anesthesia time in group 2 made at random during the premedication period revealed no prolongation until after three days of the premedication period had elapsed A two week postanesthetic period of observation revealed no toxic abnormalities in the behavior and growth of the animals.

Richert has stated that antabus® inhibits the oxidase action of xanthine oxidase which action is responsible for reoxidation of the reduced enzyme by atmospheric oxygen Apparently the dehydrogenase action of xanthine oxidase is not interfered with. For antabus® to have an effect in the whole

(4) Science 114 35-36 July 13 1951

organism, it might be expected that some time would have to elapse to allow all the dehydrogenase function to be reduced. Results of this study showed that three days of administration of antabus* were necessary before thiopental potentiation became evident, despite the massive doses, the 25 mg/mouse representing about 1,250 mg/kg. The data also lead to the inference that xanthine oxidase is one enzyme functioning in the metabolism of thiopental to thiopental carboxylic acid.

[It may be advisable to be cautious in the use of barbiturates in patients under treatment with antabuse*.—Ed.]

Blood Flow and Oxygen Consumption of Human Brain during Anesthesia Produced by Thiopental. Richard L. Wechsler, Robert D. Dripps and Seymour S. Kety[5] (Univ. of Pennsylvania) studied 12 patients on whom a minor surgical procedure was performed. All received preoperative medication consisting of 75-100 mg. demerol* and 0.4 mg. scopolamine or 10 mg. morphine sulfate and 0.4 mg. atropine. They were then given thiopental sodium intravenously, total dosage being 0.5-1.6 Gm. Cerebral blood flow was measured by the nitrous oxide method. Cerebral metabolic rate, in terms of cerebral oxygen consumption, and cerebrovascular resistance were calculated.

The most striking result was significant depression of cerebral utilization of oxygen from the normal value of 3.3 to a mean of 2.1 ml. oxygen/100 Gm. brain/minute. Average cerebral arteriovenous oxygen difference of 3.7 vol. % was significantly lower than the normal of 6.3, cerebral blood flow was slightly higher than normal. These results indicate that thiopental depresses cerebral oxygen consumption even though the quantity of oxygen available to the neurons by way of arterial blood flow is not impaired. The cerebral respiratory quotient was significantly depressed from a normal value of unity to 0.89.

Himwich and associates found what they considered to be a significant difference between results obtained by simultaneous sampling of the two internal jugular veins in the same person, although statistical analysis was not carried out. This difference was assumed to be real; it was thought to represent the difference between cortical and subcortical venous blood, each draining predominantly into

(5) Anesthesiology 12:308-314, May 1951.

one or the other jugular vein. Their results were interpreted as indicating a greater effect of thiopental on the cerebral cortex than on subcortical regions The authors found no statistically significant difference between the values obtained from the right and left internal jugular veins under anesthesia. Thus there is adequate mixing of cerebral venous blood from cortical and subcortical areas before it enters the jugular veins.

MUSCLE RELAXANTS

Effect of Certain Anesthetic and Relaxant Agents on Circulatory Dynamics F J Prime and T Cecil Gray[6] found that in dog Starling heart lung preparations ether, cyclopropane and thiopental sodium in clinical dosage invariably depressed myocardial activity The relaxant agents gallamine triethiodide, decamethonium iodide and Win 2747 had no effect.

Measurements were made of cardiac output and forearm blood flow in 15 patients anesthetized with thiopental, nitrous oxideoxygen and d tubocurarine chloride, in 10 anesthetized with thiopental, nitrous oxide-oxygen and ether, and in 6 anesthetized with thiopental and cyclopropane. Cardiac output was estimated by cardiac catheterization, using the Fick principle, and forearm blood flow by the plethysmograph. Ether initially produced a decided increase in forearm blood flow, associated with a variable rise in cardiac output. During the subsequent hour of anesthesia blood flow levels dropped lower than those in the preanesthetic period, paralleling a progressive decline in cardiac output. The effect of cyclopropane followed the same pattern, but the fall in blood flow and cardiac output over the time observed (75 minutes) was not so great, and in one case was absent. In those anesthetized with thiopental, nitrous oxide and d tubocurarine chloride there was little change

Investigation of Synergisms between D Tubocurarine Chloride and Thiopentone was made by T Cecil Gray R. A. Gregory, G J Rees and Elizabeth S N Fenton[7] in two

(6) Brit. J Anaesth. 24 101 136 April, 1952.
(7) Anaesthesia 6:144 149 July 1951

volunteers Twenty four experiments were performed at weekly intervals under closely controlled conditions Injections were given intravenously at the same rate and at the same timed intervals. Atropine, 1/100 gr, was followed immediately by a test dose of 5 mg d tubocurarine chloride. After two minutes a further 10 mg was injected, followed at once by 0 5 Gm. thiopentone in 5% solution given over 40 seconds The injections of d tubocurarine chloride were omitted on alternate weeks

Only the response to command gave a true indication of the duration of narcosis Evidence did not indicate that d tubocurarine chloride potentiated the action of thiopentone. Mean duration of narcosis in one subject after thiopentone alone was 18 83 ± 4.26 minutes after injection of thiopentone and d tubocurarine chloride it was 7 ± 3.16 minutes This would suggest that injection of d tubocurarine actually shortened the period of narcosis, statistically the difference between the means was just over the 20% level of significance In the other subject this difference, although similar, may have occurred by chance

Decamethonium Iodide (C 10) Some Observations on Its Action Using Electromyography H C Churchill Davidson and A. T Richardson[8] (St Thomas's Hosp., London) used coaxial needle electrodes to analyze individual muscle action potentials. For measurements of muscle power, supramaximal electric stimulation of the ulnar nerve was effected at wrist or elbow and total muscle action potential detected with skin electrodes.

Initial depolarizing action of C-10 was accompanied by a shower of muscle action potentials. Stimulation of the intact motor unit distal to the point of branching of the nerve fiber would be expected to produce single muscle fiber potentials however stimulation of the lower motor neuron in this area may excite the entire motor unit. Contraction of the whole unit will occur on stimulation above the area of branching Excitation of entire motor units results in a shower of whole motor unit potentials, as opposed to the single muscle fiber potentials on stimulation of the muscle fibers directly Muscle activity of apparent motor unit origin does occur with C-10 and can be seen as fascicular twitching It is unlikely that these apparent motor unit

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(8) Proc. Roy Soc. Med. 45:179-186 April 1952

charges arise from either summation of individual muscle fiber potentials or from volitional activity It remains to be determined whether they are due to direct stimulation of the lower motor neuron by C-10 or to a spinal reflex.

When partial paralysis from neuromuscular block had occurred with C-10, volitional motor unit potentials became smaller in amplitude and duration than normal. This change can only be produced by failure of some muscle fibers constituting the motor unit to contribute their part of the potential and indicates a lesion distal to the point of branching of the lower motor neuron. After complete paralysis of voluntary muscle activity by C-10, muscles still respond to direct electric stimulation. It is evident from this and electromyographic changes in innervated and denervated muscles that the site of action is at the neuromuscular junction.

Occlusion of blood supply, warming of an extremity, sympathetic block and exercise all showed that paralysis subsided much more rapidly in the part that had increased blood supply Blood flow through a muscle during exercise may be over 20 times that during rest. Use of C-10 for long operations has been discontinued because of occasional prolonged paralysis due to delayed detoxication. Peripheral blood flow is greatly increased at beginning of anesthesia, but after the first hour it has returned to normal and later may be seriously reduced Thus, use of C-10 toward the end of a long operation may when there is peripheral vasoconstriction, be followed by prolonged paralysis In continued respiratory depression use of the phrenic pulsator appears theoretically sound, since the resulting exercise should shorten the paralysis.

All of 14 control subjects given 2.5 mg C-10 showed 60% or more paralysis of hypothenar muscles, as measured by the electromyograph only 1 tolerated 2 0 mg without pronounced paralysis In contrast, 10 of 11 patients with myasthenia gravis showed a striking tolerance in 1 there were no signs of response after injection of 10 mg If the only evidence of myasthenic weakness is drooping of the eyelids, then that patient is more likely to withstand large doses than one with a more generalized weakness.

In the discussion W D M. Paton suggests a perhaps analogous situation. It has been found possible to measure the amount of potassium released by an action potential in

a nonmedullated nerve by enclosing the nerve in liquid paraffin, so that the potassium released into the thin film of saline left around the nerve could accumulate in a concentration sufficient to alter the properties of the nerve membrane. As soon as the nerve was rinsed in saline, these effects disappeared. In relatively avascular muscle, potassium accumulation in the environs of the depolarized end plate must be occurring and might accentuate the inexcitability of the membrane. Such accumulation would be much slighter in well vascularized muscle. This explains why procaine block was found a more effective antagonist than exercise, for exercise, while increasing blood flow, also causes release of potassium from the muscle fiber.

Pharmacology of Decamethonium is discussed by W. D. M. Paton[9] (Nat'l Inst. for Med. Research, London). Decamethonium and d-tubocurarine differ in their effect on various species and on different muscles in the same species. In man decamethonium affects the pharyngeal, laryngeal, facial and sometimes respiratory muscles less intensely in relation to the muscles of the trunk than does d-tubocurarine, and the muscles of the hand may also differ in their relative sensitivity to the two agents. There is an inverse relation between sensitivity to decamethonium and that to d-tubocurarine. Thus the rat is more sensitive than the cat to the latter but much less sensitive than the cat to decamethonium. The soleus and tibialis muscles of the cat show the same relation. Substances which raise the end plate threshold to acetylcholine (flaxedil,* pentamethonium, ether anesthesia) potentiate d-tubocurarine and antagonize decamethonium. Similarly patients with myasthenia gravis, although hypersensitive to d-tubocurarine, tolerate decamethonium. On the other hand, several substances diminish the blocking action of curare, whereas none of them relieves block by decamethonium and some may increase it. Finally the stimulant actions of decamethonium are entirely lacking with d-tubocurarine. It is here that the similarity of decamethonium to acetylcholine is most easily apparent.

A muscle paralyzed by d-tubocurarine is electrically normal. Its membrane potential is at all points the same as in the untreated muscle, and its direct electrical excitability everywhere the same, being indistinguishable from +

(9) Ann. New York Acad. Sc. 54 347-361 Oct. 31 1951

the normal muscle fiber A muscle paralyzed by decamethonium is quite different. The muscle membrane is depolarized, not generally, but only at the regions containing motor end plates The depolarization is not static but spreads slowly a little way along the muscle fiber with lapse of time This spread is never to the whole muscle fiber, but is such that the fall in membrane potential of a point, say 3 mm. away from the end plate, may at first be negligible but 20 minutes later is easily detectable This spread is not due to diffuse action of the drug but results from any localized depolarization During the early stages of depolarization, excitability of the end plate region is actually increased, and then it passes over (in time, depending on the dose of decamethonium) into depression of excitability Similarly, transient applications of depolarizing drugs cause only excitation, the effect of acetylcholine released in normal transmission is typical. If the depolarization is prolonged for more than a brief period, however (depending on intensity of depolarization), depression follows.

Pharmacology of Flaxedil,® with Observations on Certain Analogs. Walter F Riker, Jr., and W Clarke Wescoe[1] (Cornell Univ) state that the onset and development of paralysis which follows intravenous administration of flaxedil® to the cat are entirely like those occurring in this animal after administration of an equipotent dose of d tubocurarine Respiratory musculature is usually the last to succumb As with other compounds of this type, the resultant paralysis of the muscles of respiration is not only the direct cause of death but the sole lethal factor In the cat potency of d tubocurarine was 3 4 times that of flaxedil.® As with d tubocurarine, repeated administration of flaxedil® resulted in drug cumulation. *Both drugs seemed* to have a similar mechanism of action, and their actions summate Both are readily antagonized by the anticurare agent 3-hydroxyphenyltrimethylammonium bromide (3-OH TMPA)

On synaptic structures other than the neuromuscular junction, the actions of flaxedil® and d tubocurarine are more divergent Effects on the general reactivity of the post ganglionic cells of the autonomic ganglions were investigated by determining the pressor response of the atropinized cat

(1) Ann. New York Acad. Sc. 54:373-394 Oct. 31 1951

to intravenous injection of acetylcholine following administration of doses of flaxedil* sufficient to produce respiratory paralysis. Not only did acetylcholine continue to produce a pressor response after administration of flaxedil* but this response was consistently greater than that in non paralyzed animals, whereas the ganglionic blocking activity of d tubocurarine is well known Flaxedil* did not depress the responses of the nictitating membrane to preganglionic nerve stimulation or to intracarotid injection of acetyl choline The individuality of ganglionic and neuromuscular transmission is emphasized by this selective action. Excitatory agents such as 3-OH TMPA, the specific blocking actions of tetraethylammonium chloride and now flaxedil* reinforce this point.

In the dog doses of curare nearly sufficient to arrest respiration partially block the effects of vagal stimulation, and larger doses abolish slowing of the heart in response to this stimulus The bradycardia resulting from administration of either acetylcholine or methacholine is similarly prevented. In this respect, flaxedil* is like curare although its vagolytic potency is considerably greater In the cat, 1 mg flaxedil*/kg body weight given intravenously effected complete vagolysis, and the vagomimetic action of methacholine was prevented. The vagolytic action of flaxedil* exceeds its neuromuscular blocking action both in potency and duration, and both actions are antagonized rapidly and completely by injection of 3-OH TMPA. That the atropine like action is confined to the cardiac vagus was established by several experiments in the cat in which flaxedil* had no action on sweating salivary secretion, intestinal motility and the central action of diisopropyl fluorophosphate.

In view of this potent vagolytic action, the effect of flaxedil* on epinephrine hydrocarbon induced arrhythmias was studied in cats In all, 2 mg/kg given intravenously either prevented induction of arrhythmias or lessened their severity and duration. d Tubocurarine had a similar action.

Synthetic Curare-Like Agents and Their Antagonists are discussed by Lowell O Randall[2] (Nutley N J) Tensilon (Ro 2-3198) differs from 3-hydroxy phenyltrimethylammonium bromide (Ro 2-2561) in substitution of an ethyl for a methyl group on the nitrogen atom. Its antagonism to

(2) Am. New York Acad. Sc. 54:460-479 Oct. 31 1951.

d tubocurarine on dog neuromuscular transmission equals that of Ro-2-2561 in potency and duration. Both are about *a fourth as active as prostigmin® but the affect is much* shorter. The toxic effect on mice of tensilon intravenously is less than a third of Ro 2-2561 or a fiftieth of prostigmin.® *These two agents, although antagonistic to d tubocurarine,* also have common properties with curare. Besides having neuromuscular blocking action, curare agents can also block ganglionic transmission. Neuromuscular blocking action does not depend on the ganglionic blocking and blood pressure effects of curare like agents. Some compounds have a neuromuscular blocking action ranging from one fifth to eight times that of tubocurarine, but their ganglionic blocking action and depressor effects are much less than those of tubocurarine. These are obviously independent functions of the quaternary ammonium compounds, as noted in the decamethonium series. *Blood* pressure effects are minimal with tensilon and it is superior to prostigmin® because of its minimal stimulatory effects on intestine and other smooth muscles. *Its anticholinesterase activity is less than one one-*hundredth that of prostigmin,® which accounts for its minimal cholinergic activity.

Tensilon quickly neutralizes the neuromuscular effect of d tubocurarine flaxedil® and dihydro β-erythroidine whereas prostigminβ has a much slower neutralizing action. Tensilon does not antagonize the blocking action of decamethonium or 2 5-bis (3-diethylaminopropylamino) benzoquinone bis-benzylchloride (Win 2747) but rather has additive effects. It differentiates the true curare-like activity of the tubocurarine type from the blocking activity of the de*camethonium type. Some new polymethylene bipiperidine* derivatives which have methyl groups substituted on the nitrogen atoms are potent blocking agents of the decamethonium type and are not antagonized by tensilon. A series of compounds with aromatic substituents are only weakly active but are antagonized by tensilon. Although this drug antagonizes the blocking action at low doses, it has additive effects at toxic ones. The margin of safety between the *antagonistic dose of tensilon and the additive dose is* 40- to 80-fold for tensilon reversible curare like agents, whereas additive effects of tensilon to tensilon irreversible agents is at low dose levels.

The qualitative and quantitative properties of curare agents have been shown to depend on at least three factors. (1) The work on bisquaternary ammonium compounds established that two quaternary ammonium groups were required for high potency in synthetic substitutes for d tubocurarine. (2) The distance between nitrogen atoms in the molecule are important for obtaining optimal activity This occurred with a compound having ten carbons in the chain in the decamethonium series (3) Substituents on the nitrogen atoms modify the qualitative and quantitative activity of the blocking agents. The substitution of aromatic groups on the nitrogen atoms converts tensilon irreversible agents to tensilon reversible agents By this means, some compounds *with at least the potency of flaxedil[*] have been produced*

[It is now possible to select muscle relaxants on the logical basis of their respective effects on the electrochemical mechanisms at the end plate. The extensive studies represented by the foregoing articles make it more possible to predict with reasonable accuracy the type of peripheral effect a muscle relaxant may possess. With a knowledge of this effect, the anesthetist may anticipate the response and use the various relaxants with specificity.—Ed.]

Pharmacology of Anticurare Agents is discussed by W C. Wescoe and W F Riker, Jr [3] (Cornell Univ) Investigation of 3-hydroxy phenyltrimethylammonium (3-OH TMPA) compound proved that its cationic head the same as that in the neostigmine molecule, exerted a strong action on skeletal muscle and led to the investigation of derivative compounds. Like those of acetylcholine, small doses of 3-acetyl TMPA given intravenously have transient depressor effects effects of 3-OH TMPA are somewhat different. After atropinization each of these compounds produces pressor effects, most striking aspects of the vascular reactions, as with acetylcholine, are their promptness and rapid return to the control state. This emphasizes that the TMPA ion, and particularly its acetyl and hydroxyl derivative, has the property of direct action on structures affected by acetyl choline

These anticurare compounds have to varying degree the curariform action characteristic of quaternary amines. Given intravenously they produce violent fasciculations and respiratory failure which is peripheral and not the result of bronchoconstriction or central depression. Atropine, which

(3) Ann. New York Acad. Sc. 54 433-459 Oct. 31 1951

protects against central actions of cholinergic compounds, does not prevent death, curare, in small doses, prevents fatalities from a certainly lethal dose

Intra arterial injection of acetylcholine produces a response in mammalian skeletal muscle similar to that produced by maximal motor nerve shock. Neostigmine, 3-acetyl TMPA, 3 OH TMPA and TMPA share this property with acetylcholine This is in contrast to the effect of physostigmine and di isopropylfluorophosphate (DFP) which on intra-arterial administration is not attended by immediate twitchlike response Rather, a latent period, followed by fasciculatory responses, ensues This course would be predicted for agents acting through cholinesterase inhibition, for the responses result from endogenous acetylcholine, but only when the concentration of acetylcholine is high enough The strongly basic quaternary ammonium ion is the structure credited with direct stimulating action. Similarly, compounds containing the ion are immediately antagonistic to curare, whereas antiesterase drugs are slow in such antagonism. These data indicate that aromatic ammonium compounds, like acetylcholine, exert direct action at the motor end plate Their action may derive from sudden sharp increase in cationic concentration at the junctional region They displace curare from its action site by direct competition and once displaced curare is somehow inactivated or eliminated An expected mutually antagonistic mechanism between curare and anticurare agents has been found.

Eccles showed that the end plate potential was a local, gradually decaying depolarization of the muscle membrane by which the action potential of muscle was detonated when a critical depolarization was achieved. Curare diminished *the amplitude of end plate potential without altering* its shape or latency whereas physostigmine increased and lengthened the local negative potential change, an action antagonized by curare Neostigmine was 50 times as potent as physostigmine and over 100 times as potent as DFP in increasing end plate potential and prolonging its time to half-decay Physostigmine and DFP however were two to three times as potent as neostigmine (as shown by these compounds at high concentrations) in depressing amplitude of end plate potential. Neostigmine, therefore, acted differently from pure antiesterases.

New Curare Antagonist in Electric Shock Therapy Albert Faulconer, Jr., Edward H. Lambert and Howard P Rome[4] (Mayo Clinic) used electromyography to study neuromuscular conduction in patients undergoing electric convulsion treatments The maximal electromyographic change after intravenous administration of curare was observed about five minutes after injection. Normal recovery after effective doses of curare took over 30 minutes Administration of 0 5 mg neostigmine intravenously five minutes after the curare dose slightly accelerated recovery When tensilon, 2.5 mg for each 3 mg of curare, was administered five minutes after curare there was a substantial return of muscle action potential in less than 90 seconds. This was maintained satisfactorily and was accompanied by clinical manifestations of decurarization. Neostigmine combined with tensilon was no more effective than optimal doses of tensilon alone

Tensilon in doses of 10-20 mg was administered intravenously to counteract serious curare depression after surgical anesthesia. A few times, such use was accompanied by an unexplained reduction in pulse rate Rarely, particularly after prolonged anesthesia with pentothal,* there was a disturbing reduction of blood pressure However, a striking increase in respiratory ventilation rate always accompanied the decrease in blood pressure which may have been a manifestation of a sudden decrease of carbon dioxide tension. Actual measurement of respiratory ventilation rate of patients curarized during operation revealed a substantial increase in ventilation rate within 90 seconds after tensilon was given In one case the rate increased from 2 to 9 L/minute

Tensilon was administered about 2,000 times to curarized patients without any alarming side reactions

[Other experience with this anticurare preparation indicates that there is a point beyond which it becomes ineffective as an antidote and actually may become a muscle relaxant. This is understandable from the nature of its action at the end plate.—Ed.]

Respiratory Effect of Ro 2-3198 (3-Hydroxy Phenyl dimethylethylammonium Bromide) in Syncurinized Dogs was studied by H H. Su F T Kao and Mary Karp[5] (Northwestern Univ) Anesthetized dogs were given an intra

(4) Neurology 2:224-232, May-June 1952
(5) Science 113:742-743 June 29 1951.

venous injection of syncurine* (0 03 mg /lb body weight), followed three minutes later by one of Ro 2-3198 (0.15 mg/lb) Control experiments were run with the same dogs.

The effect of syncurine* on respiration was short, reaching maximal respiratory depressions by the fourth minute after start of injection. Then, minute volume gradually increased, returning to normal in 10 83 minutes (10 83 ± 23 64%) after administration of syncurine.* An immediate response was obtained with Ro 2-3198 A 25% increase in minute volume was noted by the end of administration and it returned to normal in 6 69 minutes (6 69 ± 19 89%) These differences are statistically significant. The respiratory depression was manifested chiefly by decrement in tidal volume Tidal volume increased within 20-30 seconds of beginning of injection of Ro 2-3198 Total ventilation returned to normal before tidal volume because of increment of respiratory rate

Repeated doses of syncurine* (without Ro 2-3198) produced constant respiratory depression. This is contrary to the effects of repeated doses of syncurine* on grip strength as reported by Macfarlane and co-workers. This may explain in part some of the clinical difficulties experienced with syncurine,* since repeated doses are less effective in producing relaxation and at the same time respiration continues to be depressed.

[Although the evidence in this article is otherwise, it is difficult to understand how tensilon can be other than additive when used in conjunction with syncurine.*—Ed.]

D Tubocurarine Chloride Concentrations in Human Plasma after Intravenous Injection during Anesthesia. Charles B Pittinger, Lucien E Morris and Stuart C Cullen[6] (State Univ of Iowa) used six adults as subjects for study The Quinn Woislawski technic was used, which is *satisfactory for determination of concentrations as low as two μg /ml. plasma*

Method.—Blood was centrifuged, 3 ml. plasma was taken, and 10 ml. acid purified ethylene dichloride and 0.5 ml. potassium iodide-glycine buffer (pH 10) were added to it. After shaking and centrifuging ethylene dichloride was decanted to a glass-stoppered centrifuge tube and 3 drops of citric acid buffer (pH 5) and several small particles of recrystallized methyl orange were added. After again shaking centrifuging and discarding the aqueous phase, a 5 ml. aliquot of the organic phase containing the d tubocurarine-

(6) J Lab. & Clin. Med. 38:39 -401 September 1951

methyl orange complex was transferred to a Klett tube and 0.5 ml. acid-alcohol added. Contents of the tube were shaken to produce a uniform, clear solution, which was pink because of methyl orange released from the complex. Optical measurements were made 10 minutes later. A standard curve which proved to be a straight line over the required range of values was developed from a series of solutions containing varying concentrations of d tubocurarine.

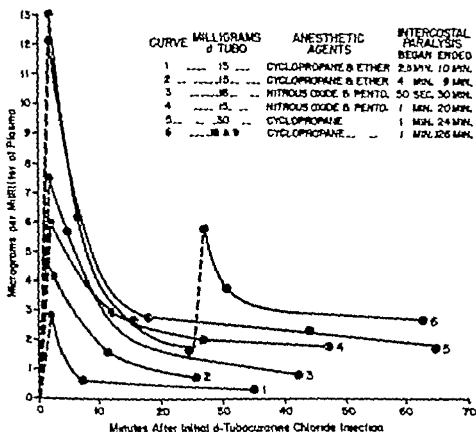


Fig. 193.—d-Tubocurarine chloride concentrations in human plasma after intravenous injection during anesthesia. (Courtesy of Pittinger, C. B., et al.: J. Lab. & Clin. Med. 38:397-401, September 1951.)

Plasma concentration of the drug fell rapidly soon after intravenous injection (Fig. 193). After 15-20 minutes, it decreased very slowly. Average time required for plasma concentrations to decrease to half the initially determined levels was 6 minutes (range 2-10). Plasma concentration increased as a result of a second intravenous injection in an amount equal to half the initial dose, and a slower fall in plasma levels was observed than that seen after the first dose. This was probably due to presence in tissue of appreciable residual amounts of the drug from the first injection.

Prevention of Postspinal Headaches by Parenteral Hydration. On the theory that headaches following spinal anesthesia are caused by lowered cerebrospinal pressure, Wallace M Shaw[7] (Hollis, N Y) studied the effect of adequate postoperative hydration in 563 patients Procaine or pontocaine® were the anesthetic agents used. An infusion of saline with (77%) or without pentothal® was started immediately after the spinal anesthesia and was continued postoperatively with normal saline and dextrose solution in water Patients of average build were given 1,000-1,500 cc isotonic NaCl followed by 1,000 cc of 5% dextrose in water Infusion was given at the rate of about 500 cc /hour until completed. Aged patients received less, young robust patients received more During the hot summer months the amount of saline was increased to compensate for loss by perspiration. All patients had infusions running when they left the operating room.

Twenty-six patients had transient headaches These were either not related to change in position or were improved by sitting up and disappeared in ½-6 hours without any therapy Six other patients had headaches which required aspirin for relief, but again these were not related to position and lasted no longer than one hour after aspirin therapy In a control series of 100 cases, comparable except for the emphasis on hydration, the incidence of postspinal headache was 7% Three lasted less than 4 days, two lasted 6 days, one 7 days, and one 10 days. In contrast to the study group most of these patients were confined to bed for several days by headache

Pencil point Needle in Prevention of Postspinal Headache It has been suggested that a needle point which would penetrate in the way a cambric needle penetrates fabric by seperating instead of cutting or tearing the fibers of the dura, would be less traumatizing It is also assumed that such a needle would lessen postoperative leakage of spinal fluid because of the manner in which it passes between or through the fibers James R Hart and R. J Whitacre[8] (Cleveland)

(7) New York J Med. 51 2905-2908 Dec. 15 1951
(8) J A. M. A 147 657-658 Oct. 13 1951

devised a 20 gauge needle with a solid end pointed like a finely sharpened pencil and with the opening on the side, proximal to the solid tip Presumably this type of needle separates the longitudinal fibers of the dura and arachnoid without seriously traumatizing them and the fibers quickly return to a state of close apposition, when the needle is withdrawn, thereby permitting less leakage of fluid. No direct evidence supports such deductive reasoning The authors noticed, however, that this needle could be inserted with little or no resistance on entering the dura, this would indicate less tearing of the fibers and therefore a smaller residual hole in the membrane

Using the ordinary 20 gauge short bevel needle in 2,070 *spinal punctures, the authors noted typical spinal type of* headache in 103 patients (5%) After the pencil point needle was adopted and used in 3,489 spinal taps, headache developed in only 69 patients (2 0%) These results were most encouraging

Treatment of Hypotensive States of Spinal Analgesia with Dilute Neo-synephrine* Solution is described by William Kreul (Racine, Wis) and O Sidney Orth[9] (Univ of Wisconsin) Neo-synephrine* hydrochloride 10 mg as a 1% aqueous solution (1 cc) is added to whatever solution is already being administered intravenously Although compatible and stable in blood, it is not added to it as the need for blood may not ever parallel the need for the drug In the hypotensive state of spinal analgesia, neo-synephrine* solution (10 mg in 500 cc) will usually raise and maintain the blood pressure The initial rate of administration (100-180 drops/minute) is gradually reduced to 40-60 drops for maintenance. If blood pressure fails to respond, a second 10 mg is added. Exceptionally when intravenous administration of fluid in quantity is contraindicated, the solution used is potent enough to maintain pressure although the rate is slowed to 6-20 drops/minute Blood pressure is the guide to the rate of administration The patient's blood pressure under both normal conditions and at the outset of anesthesia is recorded Readings are repeated at one to three minute intervals. If the blood pressure begins to fall, readings are taken at one minute intervals until the need for neo-synephrine* is decided or until the blood pressure has

(9) Anesthesiology 12 456-464 July 1951

stabilized at a satisfactory level (within 20% of the predetermined average of the individual based on the known readings)

Blood pressure response to dilute neo-synephrine* solution is often rapid and dramatic. Minute to minute determinations will prevent inadvertent development of hypertension. When the rate of administration is slowed, one may expect the blood pressure to continue to rise for one to several minutes As soon as the patient's blood pressure is stabilized, five minute check ups will suffice except after any maneuver or change of analgesia.

None of 200 records available indicated any change in the normal vasopressor action of the vessels after neo-synephrine.* Overdosage may cause unwanted hypertension. It is sometimes accompanied by headache Apparently the hypertension need not be severe In each of the eight histories in which it was encountered, headache, accompanied by restlessness and apprehension was of great intensity This can be treated effectively by giving 100-240 mg Pentothal* sodium rather rapidly to put the patient to sleep and to cause a prompt fall in blood pressure to near preoperative levels. Despite the sensitizing effect of certain general anesthetic agents on the heart, neo-synephrine* does not elicit ventricular cardiac irregularities which are common with most of the sympathomimetic amines.

Effect of High Spinal Anesthesia on Renal Hemodynamics and Excretion of Electrolytes during Osmotic Diuresis in Hydropenic Normal Pregnant Woman was studied by N S Assali, S A. Kaplan, S J Fomon, R A. Douglass and Y Tada[1] (Univ of Cincinnati)

Five normotensive subjects, aged 20-30, in the last trimester of pregnancy with no history of toxemia or renal or hypertensive disease were hospitalized and kept at bed rest for a few days before the experiment. At 4 p.m. on the day before the test, the patients received a dry meal they were instructed to ingest no water or food until after the test the next day At 8 a.m. of the day of the procedure, a spinal anesthesia catheter was introduced into the subarachnoid space and a Foley catheter introduced in the bladder Three patients were given high selective spinal anesthesia to levels of the 4th cervical vertebra with 2% procaine solution and

(1) J Clin. Invest. 30 916-924 September 1951.

two were given 1% procaine solution resulting in complete motor paralysis to levels of the 2d thoracic vertebra. Blood and urine samples were collected before and after induction of anesthesia in three similar periods.

Blood pressure dropped markedly during the first few periods following spinal anesthesia and began to return to control levels at the onset of the last period. A marked reduction in urine and renal plasma flow and glomerular filtration rate was observed during the blood pressure fall following the spinal blockade. The filtration fraction did not change. The excretion of sodium and chloride was reduced following the blockade. This reduction had no time relationship with the glomerular filtration rate reduction. The effect on potassium excretion was variable.

Changes in renal circulation after the spinal blockade were probably caused by (1) decrease in the renal blood flow caused by blood pressure fall, (2) active compensatory renal vasoconstriction mediated by a humoral agent which tended to counteract the blood pressure fall.

Earlier studies have suggested that the fall in blood pressure following autonomic blockade with high spinal anesthesia is caused either by pooling of blood in the lower extremities with a concomitant decrease in cardiac output or by a generalized blockade of compensatory vasoconstrictor mechanisms. Active vasoconstriction proceeded in the kidney during anesthesia, thus tending to negate the hypothesis that homeostatic vasoconstrictor mechanisms were paralyzed. The gradual return of blood pressure to normal values despite anesthesia is further evidence of increase in the peripheral resistance despite continuation of the autonomic blockade.

Spinal Anesthesia. Analysis of Causes of Death in 716 Cases is presented by Paul H. Lorhan and Wallace Merriam[2] (Univ. of Kansas). The anesthetic agents used with the number of deaths and mortality rate are presented in Table 1.

Complemental anesthesia, defined as additional anesthetic included in the original plan of administration, was used in 100 patients. Supplemental anesthesia, defined as additional anesthetic which it became necessary to use but which was not included in the original plan of administra

(2) Surgery 31 421-428 March, 1952.

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None of 200 records available indicated any chang the normal vasopressor action of the vessels after neo-s phrine* Overdosage may cause unwanted hypertensio is sometimes accompanied by headache Apparently the pertension need not be severe In each of the eight hist in which it was encountered, headache accompanied by lessness and apprehension was of great intensity This be treated effectively by giving 100-240 mg Pentot sodium rather rapidly to put the patient to sleep an cause a prompt fall in blood pressure to near preoper levels Despite the sensitizing effect of certain general a thetic agents on the heart, neo-synephrine* does not e ventricular cardiac irregularities which are common most of the sympathomimetic amines

Effect of High Spinal Anesthesia on Renal Hemody ics and Excretion of Electrolytes during Osmotic Diu in Hydropenic Normal Pregnant Woman was studied N S Assali, S A. Kaplan, S J Fomon, R A. Douglass Y Tada[1] (Univ of Cincinnati)

Five normotensive subjects aged 20-30 in the last mester of pregnancy with no history of toxemia or ren hypertensive disease were hospitalized and kept at bed for a few days before the experiment. At 4 p.m. on the before the test, the patients received a dry meal, they instructed to ingest no water or food until after the the next day At 8 a.m. of the day of the procedure a sp anesthesia catheter was introduced into the subarach space and a Foley catheter introduced in the bladder T patients were given high selective spinal anesthesia to l of the 4th cervical vertebra with 2% procaine solution

(1) J Clin Invest 30 916-924 September 1951

two were given 1% procaine solution resulting in complete motor paralysis to levels of the 2d thoracic vertebra Blood and urine samples were collected before and after induction of anesthesia in three similar periods.

Blood pressure dropped markedly during the first few periods following spinal anesthesia and began to return to control levels at the onset of the last period A marked reduction in urine and renal plasma flow and glomerular filtration rate was observed during the blood pressure fall following the spinal blockade The filtration fraction did not change The excretion of sodium and chloride was reduced following the blockade This reduction had no time relationship with the glomerular filtration rate reduction. The effect on potassium excretion was variable

Changes in renal circulation after the spinal blockade were probably caused by (1) decrease in the renal blood flow caused by blood pressure fall (2) active compensatory renal vasoconstriction mediated by a humoral agent which tended to counteract the blood pressure fall

Earlier studies have suggested that the fall in blood pres- ure following autonomic blockade with high spinal anes- hesia is caused either by pooling of blood in the lower :tremities with a concomitant decrease in cardiac output -- by a generalized blockade of compensatory vasoconstrictor mechanisms. Active vasoconstriction proceeded in the kidney during anesthesia thus tending to negate the hypothesis that homeostatic vasoconstrictor mechanisms were paralyzed The gradual return of blood pressure to normal values despite anesthesia is further evidence of increase in the peripheral resistance despite continuation of the autonomic blockade

Spinal Anesthesia Analysis of Causes of Death in 716 Cases is presented by Paul H. Lorhan and Wallace Merriam[2] (Univ of Kansas) The anesthetic agents used with the number of deaths and mortality rate are presented in Table 1

Complemental anesthesia, defined as additional anesthetic included in the original plan of administration, was used in 100 patients Supplemental anesthesia defined as additional anesthetic which it became necessary to use, but which was not included in the original plan of administra

(2) Surgery 31 421-428 March, 1952

TABLE 1.—Anesthetic Agents, and Mortality

Agent	Cases	Deaths	Mortality %
Pontocaine*	380	21	5.5
Pontocaine,* procaine 1 10 ratio	238	2	0.84
Procaine, continuous spinal	25	3	12.0
Procaine	58	0	0.0
Nupercaine*	15	0	0.0
Total	716	26	3.63

TABLE 2.—Combined Anesthetic Agents and Mortality

Agent	Patients	Deaths	Mortality %
Nitrous oxide-oxygen	17	3	17.6
Cyclopropane, oxygen	61	8	13.1
Nitrous oxide, cyclopropane, oxygen	29	0	0
Pentothal* sodium, cyclopropane, oxygen	4	1	25.0
Cyclopropane, ether oxygen	4	0	0
Pentothal* sodium	32	2	6.2
Local infiltration	1	0	0
Total	148	14	9.4

TABLE 3.—Complications during Surgery

1. Cardiovascular	
a) Blood pressure drop to 80 mm. Hg systolic or below	107
b) Blood pressure drop of 40 mm. Hg but remaining above 80 mm. Hg systolic	72
c) Arrhythmias	22
d) Coronary occlusion	4
e) Cerebrovascular accident	2
2. Respiratory	
a) Respiratory depression (high spinal)	9
3. Gastrointestinal	
a) Nausea and/or emesis	45
4. Miscellaneous	
a) Severe backache	2
b) Dizziness	1

TABLE 4.—Postoperative Complications

1 Cardiovascular	
a) Hypotension	19
b) Hypertension	7
c) Arrhythmia (tachycardia, etc.)	27
d) Shock	3
e) Hemorrhage	4
f) Coronary infarction	4
g) Pulmonary infarction	6
h) Cerebral embolic accident	2
2. Respiratory	
a) Pneumonia	1
b) Cough	1
c) Pain in chest	2
3. Central nervous system	
a) Headache	20
b) Convulsions	1
c) Confused or irrational	8
4. Gastrointestinal	
a) Nausea	69

tion, was used in 48 patients. Table 2 lists the agents used with the number of deaths and mortality rate for each.

In no instance did complications arising during operation (Table 3) cause death. Complications arising immediately after surgery are listed in Table 4 There were 26 deaths from all causes during hospitalization. The data indicate a relation between death and hypotensive changes during anesthesia and between death and postoperative circulatory complications All cases fall into four categories (1) No hypotensive or postoperative circulatory changes 510 patients, 3 deaths, none due to vascular causes or anesthesia (2) Hypotensive but no postoperative circulatory changes, 141 patients, 2 deaths, neither due to vascular causes. (3) Postoperative circulatory but no hypotensive changes (Table 5) 27 patients 9 deaths, only 3 due to major vascular complications and 6 due to the disease from which the patient suffered (4) Operative hypotension and postoperative circulatory changes, 38 patients 13 deaths, 12 due to vascular causes. Thus of 15 deaths from vascular causes in the entire series, 86 7% were in this group Major circulatory accidents are listed in Table 6 and other circulatory complications in Table 7 Of this group 10 of 21 whose operative blood pressure dropped to 80 mm. or below, died

This analysis leads to the following conclusions. (1) Com

TABLE 5.—POSTOPERATIVE CIRCULATORY COMPLICATIONS

COMPLICATION	No.
Hypotension	7
Tachycardia 100+	13
Shock and/or hemorrhage	4
Arrhythmias	2
Pulmonary infarction	4
Cerebral accident	1
Hypertension	1

TABLE 6.—MAJOR CIRCULATORY ACCIDENTS

Fatal hemorrhage	3
Coronary occlusion	5
Pulmonary embolism	2
Cerebral accident	1

TABLE 7.—CIRCULATORY COMPLICATIONS

COMPLICATION	No.
Severe blood pressure fall on postoperative day	11
Arrhythmias, operative to 7th postoperative day	4
Tachycardia, operative day	8
Postoperative hypertension	7

plemental or supplemental anesthesia increases hazards of spinal anesthesia. (2) Spinal anesthesia is excellent for elderly and poor risk patients, including the advanced cardiac and hypertensive patient (3) Operative blood pressure drops should be prevented in the elderly patient When severe hypotension develops in the elderly patient, even for a short interval, the vascular system is permanently damaged almost 50% of the time (4) This analysis elicited nothing which would aid in detection of patients likely to have *hypotensive and postoperative circulatory disturbances.*

LOCAL ANESTHETICS

Treatment of Peripheral Embolism by Continuous Sciatic Nerve Block. Lawrence N Cheeley[3] (Buffalo) reports a case

Man, 75, a diabetic, had extreme pain in the right leg from knee to toes and had had a cold right foot with loss of skin sensation for 16 hours. He had previously had hemiplegia but had recovered. The right leg was cold from knee to toes and cyanosis was noted over the dorsum of the foot and over the toes. Dorsalis pedis and popliteal arteries were not palpable on the right but were palpable on the left side.

A single right sympathetic lumbar block was performed with subsequent warming of the leg and foot and some relief from pain. Since he was too poor a risk for operation and repeated lumbar blocks are painful and do not produce continuous effective vasodilatation and pain relief, a single block of the sciatic nerve was performed. Relief from pain was obtained, with increase of warmth in the extremity A 4 in. 13 gauge needle was then inserted as far as the sciatic nerve using Labat's topographic markings. A no. 4 ureteral catheter was introduced through the needle and left in place when the needle was withdrawn. A Tuohy adapter was connected to the proximal end of the tubing through which injections of metycaine* were made hourly Therapy was continued for three weeks with gradual improvement in appearance of the leg Pain was much less severe after treatment. The patient had a great deal of freedom of movement with the catheter in place and was taught to administer the metycaine.*

Use of Sciatic Nerve Block for Producing Vasodilatation of Lower Extremity and Comparative Study with Paravertebral Lumbar Sympathetic Ganglion Block. Milton J Marmer[4] (New York Med College) performed 53 nerve

(3) Anesth. & Analg 31:211 212, May-June, 1952
(4) Anesthesiology 13 207-220 March, 1952.

blocks 42 sciatic and 11 paravertebral lumbar sympathetic ganglion blocks

Technic.—Sciatic nerve block was by the Labat method as modified by Judovich. With thigh flexed on trunk at a 135 degree angle, the midpoint of the uppermost portion of the greater femoral trochanter is located and the posterior superior iliac spine palpated. A line is drawn between these landmarks, it is then bisected and a perpendicular is drawn to about 3 cm. down from the midpoint. A 3½ in 22 gauge needle is inserted in a downward direction until the needle point reaches the ischial spine at which time paresthesias are obtained. The author used 10 cc. of 1% procaine as the anesthetic.

Sciatic nerve block produced maximal vasodilatation of the foot not exceeded and seldom duplicated by paravertebral lumbar sympathetic ganglion block It is easy to perform and causes little discomfort. No complications occurred in this study and none have been reported in the literature It relieves intermittent claudication Motor and sensory loss last only about 45 minutes after block. Patients are euphoric after the anesthesia wears off Increase in temperature is sustained for at least one hour after nerve block.

Controlled Study of Pain Relief by Intravenous Procaine was made by Arthur S Keats Genesio L D'Alessandro and Henry K. Beecher[6] (Harvard Med School) in 53 patients who the day after a major surgical procedure, had constantly present wound pain of moderate or severe degree

Procedure.—When a suitable degree of pain developed, the patient was given the first drug of a series (saline, procaine morphine) and the degree of pain relief evaluated at specific intervals thereafter (usually 30 and 60 minutes) If little or insufficient relief was obtained the second drug was given and its effect evaluated. The third drug was then given. If pain relief followed any dose the subject was observed at intervals until pain returned to approximately the original level and then the series of drug administrations continued. Procaine was given intravenously as a 0.1% solution in 5% dextrose in water Saline was given in a similar manner at a rate of about 200 cc./hour Morphine was given slowly by syringe over one minute dosage was always 8 mg./70 kg body weight.

In one group of 12 patients, the "procaine unit" (4 mg./kg over 20 minutes) was the dose used and was found ineffectual. In two other groups, therefore procaine was administered (as rapidly as possible without producing side reactions) up to the limit of tolerance for 20 minutes and then allowed to drip in slowly for 40 minutes. The order of administration in group 2 was saline, procaine and morphine and in group 3 procaine, saline and morphine. Saline was not given to a fourth group, but procaine-ascorbic acid mixture was given first (0.1% procaine, 0.1% ascorbic acid solution)

(6) J. A. M. A. 147 1761 1763 Dec. 29 1951

Over-all results showed at the 30 minute interval a therapeutic effect (relief from pain and discomfort) of saline in 20%, of procaine in 40% and of morphine in 70% of patients. The addition of ascorbic acid permitted administration of greater amounts of procaine than would otherwise have been possible without serious side actions, but this was not accompanied by increased analgesia. The degree of relief produced by procaine approximated that produced by 90 mg pentobarbital sodium. Intravenous procaine caused numerous unpleasant side actions. Most often observed were dizziness (68%), nausea (45%) vomiting (23%) and generalized numbness (30%) Many patients begged that procaine infusion be stopped Unless procaine administered intravenously, can be demonstrated to produce significant beneficial effects on specific disease processes, it has no place in the treatment of pain.

Medial Approach for Paravertebral Somatic Nerve Block is described by Wallace M Shaw[5] (Prospect Heights Hosp., Brooklyn) With this method the subarachnoid space is

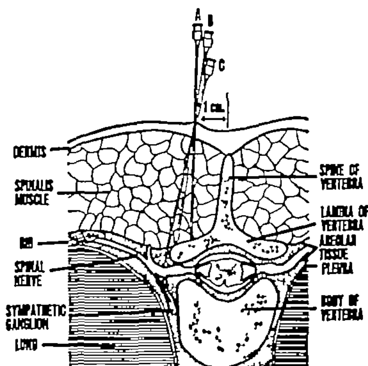


Fig. 194.—Positions of needle in blocking spinal nerve by medial route. Needle in contact with lamina (*A*) sliding laterally along lamina (*B*) and in correct position for injection (*C*) (Courtesy of Shaw W M. J A. M. A. 148:742 744 Mar 1 1952.)

(5) J A. M. A. 148 742 744 Mar 1 1952.

avoided almost entirely and localization is extremely accurate The technic is easy to perform and is less painful than other methods The possibility of causing pneumothorax is minimized.

TECHNIC.—The patient is placed in prone position The important area to be localized is the space between the transverse processes, the location of both the intervertebral foramen and the spinal nerve. A skin wheal is raised 1 cm. from the midline on the side to be blocked. A 3 in., 22 gauge needle is inserted at right angles to the frontal plane until the lamina of the vertebra is contacted (Fig 194) The needle is partially withdrawn and its point redirected more laterally, until it just slips off the edge of the lamina, it is then advanced 1 cm. farther If the needle still contacts bone at an angle of about 45 degrees, it is probably "walking" along a transverse process or rib. It is then necessary to direct the needle superiorly or inferiorly through the same skin wheal or a new one

Before anesthetic solution is injected a careful check should be made of whether the subarachnoid space, pleural cavity or a blood vessel has been entered. If the needle has been correctly placed, its point lies in a triangular space bounded medially by the body of the vertebra, anteriorly by the pleura or peritoneum and dorsally by the fascial covering of the sacrospinalis muscle Anesthetic solutions injected into this space are close to the spinal nerve.

Analgesia Following Anorectal Surgery Using Oil-Soluble Anesthetic was studied in 540 anorectal operations by Robert Ehrlich[7] (Boston) Intracaine® in oil was the anesthetic agent A 2% solution, used in 50 operations, was found inadequate so a 5% solution was used on the rest. Of a total of 12 cc., 8 cc was dispersed into the right and left posterior anal quadrants close to the anal canal and into the lateral and anterolateral quadrants. The other 4 cc was kept until after surgery when it was injected in divided amounts to float each of three or four marginal wounds This produced analgesia at the skin wounds sites.

In general, intracaine® in oil is satisfactory and has some advantages over other agents When injected as the first step in the operative procedure sphincter relaxation above that affected by the primary anesthetic was evident almost before completion of the procedure Tolerance to this preparation, seen in absence of headache, nausea and vomiting, is apparent. Postoperative pain is markedly decreased, and the period of anesthesia and analgesia more prolonged. There were no abscesses nor sloughs and no evidence that wound healing was delayed or affected

(7) Am. J Surg. 83:184-188 February 1952.

Pharmacologic and Clinical Studies with Antispasmodics and Local Anesthetics on Upper Digestive Tract George P Child[8] (Albany Med College) studied atropine, homatropine, syntropan,* pavatrine,* trasentine,* asymatrine,* banthine, procaine, pontocaine,* nupercaine,* larocaine,* butacaine and SKF* 538A. Concentrations of the drugs required to relax spasm of an isolated section of rabbit ileum induced by barium or acetylcholine and the amounts required to depress its normal motility were determined. Acetylcholine is alleged to have a neurotropic effect and barium a musculotropic one Inhibition of porphyrin-stained tears produced by acetylcholine in rats was also studied. The human studies were conducted on volunteer medical students and patients with peptic ulcer

In the experiments on rabbit ileum, atropine was by far the best anticholinergic drug Several compounds effectively relaxed barium spasm. Potency of the drugs as local anesthetics was highly correlated with their effectiveness in relaxing normal motility and barium induced spasm The two isoquinoline drugs, nupercaine* and SKF* 538A, were about equally as good in depressing the spontaneous contractions Small amounts of atropine homatropine or banthine (given intraperitoneally) were required to inhibit the chromodacryorrhea response to acetylcholine in rats. Of the remaining drugs, effective amounts bordered on their lethal doses and some were completely ineffective.

In the human subjects, all the drugs inhibited motility induced by urecholine* but there was considerable variation in their effectiveness. The second administration of urecholine* invariably produced a return of some motility Atropine, banthine and the isoquinoline drugs, however, were the best agents against urecholine* induced spasm. No drug completely inhibited secretion of acid, and the variation in their effectiveness was great

In the therapeutic trials all the anesthetics and spasmolytics were effective in relieving the pain of peptic ulcer or pylorospasm. Psychic relief was observed after administration of placebos, and, although of short duration, increased the difficulties in arriving at a therapeutic dose Subsequent tests, however confirmed the approximate doses listed in the table. No attempt was made to study the effects of all

(8) Gastroenterology 19 126-136 September 1951

Therapeutic Doses of Antispasmodics and Local Anesthetics for Disorders of Upper Digestive Tract

Drug	No. of Tests	Oral Dose, Mg.	Gastric Analysis: Control, Vol. Ml.	Control, Acidity Units, Free	Control, Acidity Units, Total	Before Second Urecholine●, Vol. Ml.	Before Second Urecholine●, Acidity Units, Free	Before Second Urecholine●, Acidity Units, Total	After Second Urecholine●, Vol. Ml.	After Second Urecholine●, Acidity Units, Free	After Second Urecholine●, Acidity Units, Total
Atropine	3	0.5-1.0	20	11	21	21	32	36	20	29	37
Homatropine	3	2-4	32	20	26	27	28	38	22	31	40
Banthine	3	50-100	27	13	30	15	21	29	15	21	28
Syntropan●	3	100-200	22	9	19	21	36	41	25	38	49
Trasentine●	3	75-150	39	12	26	30	29	33	21	33	41
Pavatrine●	3	125-200	32	13	25	19	31	12	26	25	32
Asymatrine●	8	10-100	40	29	58	33	46	56	29	31	40
Procaine	3	100-300	27	19	27	26	31	40	17	25	31
Pontocaine●	1	5-20	29	11	19	20	28	35	21	28	33
Larocaine●	1	10-20	29	13	23	13	22	29	18	25	28
Butacaine	1	5-10	31	10	21	29	31	40	31	27	37
Nupercaine●	8	5-10	10	11	19	26	22	27	13	18	23
SKF●538A	4	5-10	36	21	25	22	29	31	11	16	21
Urecholine● (control)	5	5-10	39	25	37	56	18	57	N●	N	N●

…nolytic given.

drugs over a prolonged period. Fourteen patients receiving nupercaine* were studied for three months to one year The most usual result was complete elimination of gastrointestinal pain in 5-15 minutes. The isoquinoline drugs and banthine were most spectacular in this respect. It was difficult to evaluate duration of this relief. Ulcer patients had no recurrence of symptoms for periods ranging from a few hours to several weeks after a single dose of nupercaine.*

Few toxic effects were observed. Pontocaine* produced retro-orbital pressure and a feeling of lightheadedness in two of three patients Atropine homatropine and banthine produced the usual side effects, including dry mouth and blurred vision.

Stellate Ganglion Block in Treatment of Acute Subdeltoid Bursitis. Everett J Gordon[9] (Washington, D C) reports results in 36 cases. The ganglion block breaks the reflex arc which produced constriction of the precapillary sphincters and thereby interrupts the venocapillary paralysis stasis and diapedesis The more nearly normal flow of blood *through the true capillaries and the consequent increase in* lymph flow relieves edema and pain and explains the prompt symptomatic relief. Murphey's anterolateral approach was found most effective and comfortable

Results were most striking in acute, severe bursitis of recent onset. There was immediate, dramatic pain relief, with increase in active and passive shoulder motion. Although a mild relapse sometimes occurred when the effect of the block disappeared, further improvement followed one or two additional blocks given at intervals of one or two days. Rarely a fourth block was required to clear mild residual symptoms.

In two mild cases, one or two blocks were required to restore completely normal function within 72 hours in 15 of moderate severity an average of two blocks produced excellent results in 40% within 72 hours and in 86 6% within 1 week, and in 19 severe cases an average of three blocks restored normal function in 89 4% within 1 week. Six patients with severe bursitis had a normally functioning arm after 72 hours. Use of an oral vasodilator drug was tried in two patients but the results were not encouraging

Calcareous deposits were detectable on x ray in 29 of 34

(9) J Internat. Coll. Surgeons 16 185 198 August, 1951

patients studied. After 6-18 months there was marked or complete absorption of calcium in 16 of 18 patients followed. Of 25 patients followed for 1-4 years, only 2 had mild recurrences, 7 and 12 months later. These promptly cleared with one physical therapy treatment. The only untoward effects were a procaine reaction, transitory cervical and scapular pain from piercing of the prevertebral fascia and occasional numbness of the arm. Pneumothorax, hydrothorax, air embolism, fatal subarachnoid injection, phrenic nerve paralysis and cardiorespiratory paralysis from a vagal inhibitory reflex may occur. The injection should therefore never be lightly regarded or performed in the clinic or office unless proper resuscitation equipment is available.

Splanchnic Block in Surgery of Gallbladder and Stomach is described by James C McCann[1] (Tufts College)

TECHNIC.—With the patient anesthetized, usually with pentothal* sodium supplemented by cyclopropane and curare, two broad-bladed retractors are placed under the left and the adjacent portion of the right lobes of the liver retracting them upward. The caudate lobe has a purplish brown appearance behind a thin screen of the lesser omentum. With the lesser omentum tensed by downward traction on the stomach with the left hand, a vertical rent in this omentum is made directly over the tip of the caudate lobe. This permits the caudate lobe to move forward into the rent so that its tip presents in front of the omentum. Usually this area is free from fat and completely avascular. In extremely thin persons nothing is gained by opening the omentum. The tip of the left middle finger is advanced cautiously through the rent into the lesser omental bursa, until it comes into direct contact with the body of the first lumbar vertebra. There are now no obscuring membranes between the finger tip and the bone. The pulsating aorta is identified above the celiac artery and the upper border of the pancreas.

The finger and hand are then withdrawn. The needle guide for splanchnic injection is fitted over the distal phalanges of the left middle finger. The left hand is again placed in the position of retraction over the stomach, again advancing the middle finger this time bearing the needle guide under the caudate lobe and into the lesser omental cavity to contact the first lumbar vertebra. Pressure firmly applied to the patient's left against the pulsating aorta and downward against the bone safely separates the aorta from the inferior vena cava. A strong 15 cm., 18 gauge needle, attached to a syringe, is inserted in the proximal opening of the small needle guide, through which it is easily and accurately advanced until it impinges abruptly and definitely on the first lumbar vertebra, directly over the tip of the nail of the middle finger and separated from it by a few millimeters. If desired, the needle guide may be

(1) Anesth. & Analg. 30:181-184, July-Aug., 1951

slightly rotated so that the needle can advance a fraction to the right or left of the middle of the finger tip, depending on the underlying anatomy of the aorta. When there is firm contact by the needle against the body of the vertebra, 6 cc. of a 2% procaine solution is injected During a long operation 5 cc. and 3 cc. may be repeated hourly

Almost immediately respiratory quiet and relaxation pervade the whole subdiaphragmatic region, with complete obliteration of the disturbing reflex stimulation of respiration previously produced by traction on the upper abdominal viscera or their mesenteries. The high concentration used is immediately effective the small quantities limit diffusion, so that a significant drop in blood pressure rarely was encountered.

This splanchnic block has been reported by others, but the larger amounts (80-250 cc.) of anesthetic solutions used infiltrate the retroperitoneal area down to the pelvis, producing physiologically an extended Smithwick operation

[This very useful procedure is often overlooked.—Ed.]

Prolonged Peripheral Nerve Block by Means of Indwelling Plastic Catheter Treatment of Hiccup (Note on Electrical Localization of Peripheral Nerve) Stanley J Sarnoff and *L. Charlotte Sarnoff*[2] *(Harvard Univ) describe a* method.

TECHNIC.—After the skin wheal is made a no 18 needle is inserted to the desired point, a polythylene tubing containing a stilet is then inserted to the full length of the needle, the needle gently withdrawn and *the stilet removed.* A no 23 needle is inserted in the end of the tubing and the anesthetic agent injected. When the desired block has occurred, a needle stopper is secured in the hub of the needle. Probably the most important step is to secure the plastic tubing to the skin A heavy coating of collodion is applied to the skin in a circle with a 1 in. radius from the point of emergence of the tubing so as to make the tubing adhere firmly to the skin surface. Narrow adhesive strips wound several times around the tubing are then fixed to the skin at the rim of the collodion circle. The rest of the tubing with the needle in its end and the needle stopper are then folded in a sterile gauze sponge and taped in place

This technic was successful with patients who had intractable hiccup The electrophrenic respirator was used to localize the external motor point of the phrenic nerve The no 18 needle was here inserted and made to follow the downward course of the anterior surface of the anterior scalene muscle over which the phrenic nerve passes It was

(2) Anesthesiology 12 270-275 May 1951

sometimes possible to sense the passage of the needle through the prevertebral fascia which overlies this structure Fluoroscopy is highly advisable, since gross observation of the diaphragm does not always reliably establish which side or sides are producing the hiccup

In two patients a stimulating needle with all but the tip insulated with baked-on silicon was inserted to the point where the phrenic nerve passes over the anterior scalene and was tested electrically The position of the needle point was carefully varied until the maximal diaphragmatic response was obtained with the lowest possible voltage The lead wire clip was removed and the needle left in position until the plastic catheter was inserted The electrophrenic respirator was the source of current, but any appropriate impulse generator could be substituted Since motor fibers have a much lower electrical threshold than pain fibers, motor activity occurs at a lower current density than that at which pain fibers are activated and as a result the only sensation experienced by the patient is the appreciation of the externally induced motor reaction.

Diminution in the hiccups without abolishing them may occur either because they are bilateral initially or because not all the phrenic nerve fibers are blocked. In bilateral hiccups, the procedure may have to be repeated on the second side which in the absence of pulmonary parenchymal involvement, is without hazard in view of the extent of the respiratory reserve However the possibility of blocking the vagi does exist if the procedure is bilateral the vocal cords should be visualized before injection is made on the second side not sooner than 30 minutes after injection into the first side

Toxicity of Xylocaine A. R Hunter[2a] found that for xylocaine intravenously the LD_{50} in white mice lay between 25 and 37.5 mg/kg., whereas for procaine it was 75 mg/kg Subcutaneously that of xylocaine (2% solution) was 375 mg/kg and that of procaine (5%) was 1,200 mg/kg Phenobarbitone in a dose which produced only mild drowsiness and ataxia in mice had no protective effect against the lethal effect of either procaine or xylocaine. However, with virtually an anesthetic dose an increase of some 20% in the LD_{50} was observed both in intravenous and subcu

(2a) Brit. J Anaesth. 23 153-161 July 1951.

taneous administration Addition of 1 200,000 epinephrine to solutions of procaine or xylocaine did not reduce their toxicity to mice

Experiments in rats, rabbits and cats similarly showed xylocaine to be about twice as toxic as procaine

Dermatitis from Local Anesthetics The paucity of reports of the sensitizers among the local anesthetic drugs is surprising because sensitization occurs frequently C Guy Lane[3] (Boston) and Ralph Luikart II (Santa Barbara, Calif) review 107 cases of epidermal hypersensitivity in the literature

A positive patch test confirmed 78 cases (73%) Responsible drugs in decreasing order of frequency are procaine, orthoform, picrate, pontocaine,* nupercaine,* benzocaine, butyn,* apothesine,* larocaine* and metycaine * Collateral sensitivity among these similar organic compounds is not infrequent and may be wide A recent survey of dentists indicated a rather high proportion who had become sensitized to local anesthetics.

Thirty cases of epidermal procaine hypersensitivity were found Positive reactions to patch tests confirmed 66% Considering the number of patients whose skin surface inadvertently contacts procaine and that 83% of those with reported sensitivity use it frequently (dentists and physicians) many exposures seem necessary to develop epidermal procaine hypersensitivity the condition seems an occupational disease basically Reported reactions in the literature probably represent a low index of true incidence

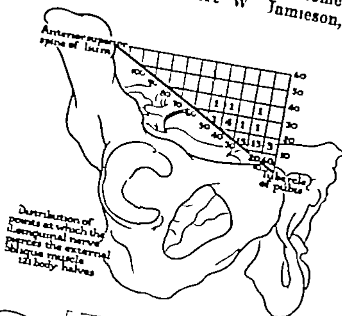
Epidermal hypersensitivity to tetracaine (pontocaine*) was noted in 14 cases. Thomas made patch tests on 201 endoscopy patients and found 20 with 1 or 2 + reactions and 3 with suggestive reactions Considering this incidence of hypersensitivity the literature would again appear to give a low index of occurrence of sensitivity External epidermal tetracaine hypersensitivity is most prevalent in ophthalmologists and their patients.

Such localized sensitivity may mean generalized sensitivity in any given patient It would seem unwise to prescribe a local anesthetic preparation for topical use without being alert for the occurrence of epidermal hypersensitivity at any time. Caution about the possibility of such

(3) J A. M. A. 146 717 720 June 23 1951.

sensitization should also be issued in all advertising material which concerns these agents

Points of Parietal Perforation of Ilioinguinal and Iliohypogastric Nerves in Relation to Optimal Sites for Local Anesthesia In inguinal herniorrhaphy it is common practice to use local anesthesia, however, the standard method of producing lower abdominal anesthesia sometimes fails to block pain sensations. Robert W Jamieson, La Vern L.





Figs. 195 (top) and 196 (bottom).—Points of perforation of abdominal wall by ilioinguinal nerve. Data from both body halves are combined on right side. (Courtesy of Jamieson, R. W., *et al* Quart. Bull. Northwestern Univ M. School 26-22-26 Spring, 1952.)

Swigart and Barry J Anson[4] carried out dissections on external and internal oblique and transversus abdominis muscles in a large series of specimens to locate the point of parietal perforation of the ilioinguinal and iliohypogastric

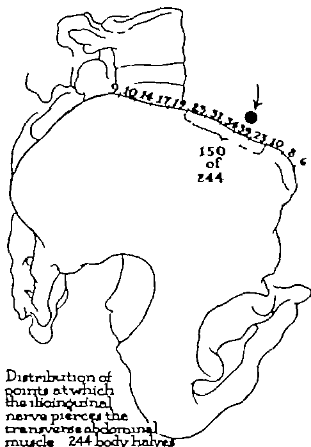
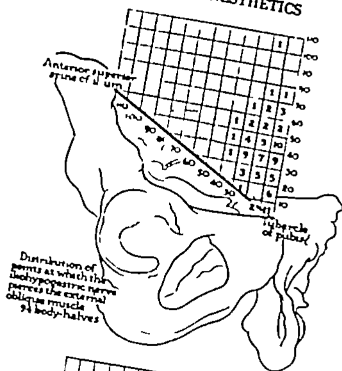


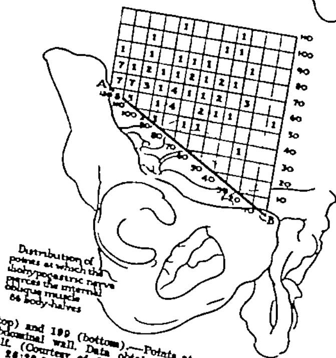
Fig. 197.—Arrow shows site of optimal effectiveness for injection into nerves in anesthetizing the hernial region. (Courtesy of Jamieson, R. W., et al Quart. Bull. Northwestern Univ M. School 26 22 26 Spring 1952)

divisions of the first lumbar nerve through the inguinal portion of the abdominal layers.

Figures 195-197 indicate points of perforation of the musculoaponeurotic layers of the abdominal wall by the ilioinguinal nerve Figures 198-200 those of the iliohypogastric nerve The studies reveal that the optimal point for anesthetic block of the entire nerve supply of the lower abdominal wall would be 4-6 cm. posterior to the anterior superior spine, along the lateral aspect of the external iliac lip,

(4) Quart. Bull. Northwestern Univ M. School 26:22 26 Spring, 1952.





FIGS. 198 (top) and 199 (bottom).—Points at which iliohypogastric nerve pierces anterolateral abdominal wall. Data obtained from both sides are combined on the body' right half. (Courtesy of Jamieson, R. W., *et al.* Quart. Bull. Northwestern Univ M. School 26:22 26 Spring 1952)

where the two nerves lie together as they perforate the transversus muscle

PROCEDURE.—With the patient supine, the first intradermal wheal is made near the free end of the twelfth rib. The intradermal injec-

tion is then directed posterolaterally to the midpoint of the iliac crest. At this point the needle is advanced so as to impinge on the iliac crest. Most of the anesthetic agent should be injected along the iliac crest toward the anterior and posterior superior iliac spines. The subcostal nerve may be blocked by injecting the solution between the internal oblique and transversus abdominis muscles in a direction extending from the midpoint of the iliac crest to the ante-

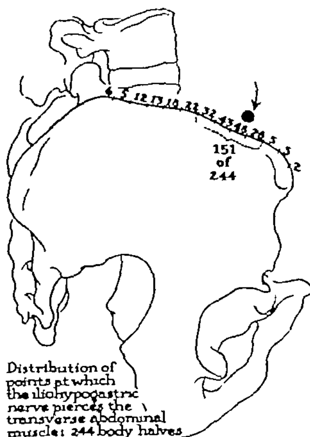


Fig. 200.—Preferred site for injection is indicated by the black circle. (Courtesy of Jamieson, R. W., *et al.*: Quart. Bull. Northwestern Univ. M. School 26:22-26, Spring, 1952.)

rior aspect of the twelfth rib. *Intradermal infiltration in the mid* line area from the pubic symphysis toward the umbilicus will satisfactorily block nerves overlapping from the opposite side. Infiltration in the area of the subcutaneous inguinal ring may be required to block the pudendal extensions of the genitofemoral nerve.

With the anesthetic agent thus injected complete analgesia of the lower abdominal wall should result; muscle tension in the operative area and distortion of the fascial planes by the anesthetic solution would be obviated.

Importance of Blood Volume Studies in Management of Surgical Patients Chronically ill patients have a syndrome characterized by weight loss, decreased blood volume, decreased blood protein content and increased interstitial fluid volume Morris J Nicholson and Frederick G Jensen[8] (Lahey Clinic) found that deficiency of hemoglobin and depletion of body proteins generally remain undetected in such patients.

Because these patients are more susceptible to shock, it is important to correct any blood volume deficit preoperatively Total blood volume can be calculated by the Evans blue dye method When this is not feasible for measure of blood volume deficit, 40 cc whole blood/lb of reduction from normal body weight should be given preoperatively

AVERAGE BLOOD LOSS AT OPERATION (IN CC.)

	COLLIER	LAHEY CLINIC
Radical mastectomy	808	
Thyroidectomy	377	298
Operations on biliary tract	435	
Colectomy	413	832
Gastrectomy		360
Spine fusions and arthroplasty		866

Once blood volume has been restored, it is equally important that provision be made for adequate replacement of operative blood loss The table indicates average blood loss in some major surgical procedures.

Postoperative blood loss may be pronounced and must be anticipated because it is usually insidious. It is noted most often in patients who have bloody drainage after such procedures as thoracentesis, urologic operations and gastrointestinal resections. It has been shown that depleted red blood cell volume has little tendency for spontaneous recovery during the first 10 postoperative days Hemoglobin formation takes precedence over tissue protein regeneration thus wound healing will be delayed or dehiscence may occur If the patient is properly hydrated, serial hematocrit readings will show any postoperative deficit.

(8) Current Res. in Anesth. & Analg. 31:27 35 Jan. Feb., 1952.

It must be stressed that the chronically ill surgical patient who has lost weight must have reduced blood volume despite hemoglobin, hematocrit and plasma protein values within normal limits

Transfusion Reactions in Multiple Transfusions John E Osborn and Thomas H. Seldon[6] (Mayo Clinic) studied 591 patients who were given 2,260 transfusions to determine reaction rate with multiple transfusions. It was found to be 8 4%

The patients' sex and age of the blood transfused were not significant in determining rate of untoward reactions. *Pyrogenic reactions were most frequent and group A patients had most frequent untoward reactions*

From the table it appears that if a graph were drawn the reaction rate would take the form of an S curve Thus, it

First Appearance of Reaction According to Number of Transfusions

	Reaction to				
	1st Transfusion Only	2d; No Reaction to 1st	3d; No Reaction to 1st or 2d	4th; No Reaction to 1st, 2d or 3d	5th No Reaction to 1st, 2d, 3d or 4th
Patients undergoing transfusion	591	548	272	175	100
Reactions	43	29	14	11	9
Reaction rate, %	7.3	5.3	5.1	6.3	9.0

is possible to postulate how the reaction rate of any particular patient may vary according to sequence of the transfusion.

If a person has a reaction on first transfusion, he is more likely than others to have a reaction with the second. Approximately one in four had reactions on both first and second transfusions. This observation is important because of increase in the number of patients who reacting with the first transfusion, are possible candidates for reaction with another transfusion.

Anesthesia and Reduction of Blood Loss W N Rollason[7] developed a technic to produce not only a nontoxic nonexplosive light narcosis, with muscular relaxation and control of respiratory movement, *but also a relatively blood less surgical field.*

(6) Current Res. in Anesth. & Analg. 31 58-62 Jan. Feb., 1952.
(7) Anaesthesia 7 10-18 January 1952

TECHNIC.—The average adult receives 3 gr nembutal* the evening before operation and ½ gr omnopon and 1/150 gr scopolamine 1½ hours before operation On arrival in the operating room, blood pressure is taken, after which 0.5 Gm. of 5% thiopental sodium, followed by 80 mg flaxedil,* are injected intravenously The lungs are then inflated with pure oxygen and tracheal intubation is carried out. Nitrous oxide-oxygen mixture (3½ 1¼) is then administered by means of the semiclosed circle absorption technic. As soon as the patient breathes spontaneously, 50 mg pethidine is injected intravenously Blood pressure is taken again and a test dose of 3 mg C5 (pentamethonium iodide)/14 lb body weight injected intravenously (By blocking the autonomic ganglions this causes general vasodilatation and fall in blood pressure) The patient is positioned when possible so that the site of operation is the highest point and the legs are dependent. By additional injections of C5 systolic blood pressure is reduced to 60-80 mm. Hg before the skin is incised. Additional small doses of pethidine and/or of flaxedil* are injected whenever they appear necessary (Movement or rapid breathing indicate a need for pethidine whereas inadequate relaxation or troublesome diaphragmatic movement indicate a need for flaxedil.*) Constant vigilance is essential, no anoxic episodes are permissible and amount of blood loss should be assessed as the operation proceeds.

In general, younger patients and those with raised BMR require large doses of C5 and positioning appears to be an essential adjunct. In the frail and cachectic patient, use of C5 may be unnecessary Whenever C5 fails to reduce pressure adequately and bleeding of any degree results, immediate replacement therapy is essential as the vasomotor system is no longer under normal control. Great caution is necessary in giving any additional doses of thiopental sodium to a patient under C5, as a sudden severe fall in pressure may ensue A vasopressor agent should be available for immediate use

Contraindications to use of C5 include patients with a history of angina frail and cachectic patients cesarean section shock, especially when blood volume is reduced and there is compensatory vasoconstriction, poor renal function, in which prolonged hypotension may precipitate renal failure tendency to cerebral thrombosis hypertension complicated by chronic pulmonary disease, hypotensive states such as Addison's disease cardiac surgery and children.

Rollason also used C6 (hexamethonium iodide) to produce hypotension. It seemed more certain and effective in its action than C5, particularly in major upper abdominal and intrathoracic procedures. An initial dose of 50 mg is given and repeated in five minutes when necessary

Hypotensive Anesthesia in Plastic Surgery Use of the methonium compounds, with postural control, to produce hypotension under anesthesia in plastic surgery is advocated by Jack Penn and H Bentel[8] (Johannesburg) The reduction in bleeding improves surgical accuracy, lessens trauma and the amount of suture material buried, shortens operation time and reduces postoperative edema and bruising to a minimum Less anesthesia is needed under low pressure, and this seems to diminish the incidence of postoperative discomfort and sickness.

A complete preoperative physical examination and history are essential, with particular attention to the cardiovascular renal systems Coronary disease and nephritis are contraindications to hypotensive anesthesia. For premedication the authors use 1/6 gr omnopon and 1/75 gr atropine an hour before surgery The patient is given intraval (0.5 Gm.) and flaxedil* (60-80 mg), intubated and then maintained on gas-oxygen-ether, using a circle absorption system with the respiratory valve open When he is settled the blood pressure is taken and the table tilted 30-40 degrees to the foot-down position. After three minutes the blood pressure is taken again and any difference noted Hexamethonium dosage is assessed from these readings. The usual dose is 50 mg for young healthy adults 30-40 mg for patients over 40 and 20-30 mg for patients over 50 and those who have mild hypertension or a fall in pressure due to posture alone

Hexamethonium bromide is given intravenously the blood pressure should come down within five minutes. If it does not, half the initial dose is given and if this has no effect the method is abandoned. Blood pressures between 50 and 60 mm Hg should be maintained. The effect of the initial dose of the drug usually lasts 30-40 minutes sometimes hypotension can be maintained at the end of this period by increasing the tilt of the table Subsequent doses vary from 10-25 mg The last injection should be given not less than 20 minutes before completion of the operation. All surgery must be finished before the pressure is allowed to rise.

Surgical shock is not a feature as the autonomic ganglions have been paralyzed. Uncontrolled bleeding even to a minor extent may be catastrophic if replacement is not immediate

(8) South African M J 26:9-11 Jan. 5 1952

The authors have used this method in 100 patients. Results in 86% were good to excellent. In 11% hemostasis was fair In 3%, operative bleeding was not influenced Venous thrombosis, cerebral anemia, intestinal ileus, renal breakdown or any other complications that may be attributed to autonomic paralysis or extremely low blood pressure were not observed These complications can be avoided by correct selection of patients, careful blood pressure readings throughout, full oxygenation, avoidance of prolonged operations and adequate after treatment.

This method should be used only by skilled anesthetists Full co-operation between anesthetist and surgeon and between doctors and nursing staff is essential Good postoperative care is mandatory

Caution with Regard to Use of Hexamethonium and Apresoline K. S Grimson, E S Orgain, C R Rowe, Jr., and H. A. Sieber[9] (Durham, N C) describe the action of each of these drugs alone and in combination.

Hexamethonium chloride is a ganglionic blocking agent available in 250 mg tablets for oral ingestion. All patients should be hospitalized for careful observation on institution of therapy Initial dose is 125 or 250 mg Subsequent dosage suggested is one tablet at each of four intervals on the first day to a total of 1 Gm. If tolerated, two tablets should be given at each of four intervals the second day—a total of 2 Gm. Maximum dose is 5 Gm. a day, incidence of serious side effects increases as doses exceed 2-3 Gm. daily Variability of results of "total" sympathectomy suggests that the dose cannot be adjusted solely by its effect on blood pressure. Therapy for regular reduction of blood pressure could cause overdosage, as certain hypertensive patients would not or could not safely have definite sustained reduction. Significant parasympatholytic side effects and postural hypotension seem more reliable as guides for adjusting hexamethonium dosage for the individual patient. Among serious side effects are prostrating hypotension, obstipation and ileus

Apresoline is weakly adrenolytic and sympatholytic Blood flow through the kidney increases although systemic arterial blood pressure may decrease with its use The authors gave six patients 25-100 mg every four hours orally Pressure

(9) J A. M. A. 149:215-220 May 17 1952

was moderately reduced for a time The drug is considered relatively ineffective It causes moderate tachycardia and may produce mild edema of the periorbital region, hands, feet and genitalia.

Combined use of hexamethonium and apresoline is still being investigated and should only be undertaken with extreme caution First hexamethonium is used in dosages described, apresoline is added after a week or more Uremia, cerebrovascular accidents, multiple myocardial infarcts and sudden death have been reported.

If use of either or both drugs is contemplated, the patient should have careful, complete physical examination, previous evidence of arterial insufficiency should be ascertained. Examination should include retinoscopic study, ECG and renal evaluation, including nonprotein nitrogen value and phenolsulfonphthalein excretory function test Patients with previous sympathectomy or with encephalopathy or damaged myocardium tolerate smaller doses All patients need careful instruction as to side effects and associated hazards, they should be alerted to reduce or vary dosage according to symptoms.

[Although there is evidence that use of hypotensive agents is a useful adjunct to extensive surgery in which blood loss is a major factor one must not overlook the hazards associated with this technic.—Ed.]

MISCELLANEOUS

Effects of l Epinephrine and l Nor Epinephrine on Cerebral Circulation and Metabolism in Man were studied by Benton D King, Louis Sokoloff and Richard L Wechsler[1] (Univ of Pennsylvania) Epinephrine increased mean arterial pressure and cerebral blood flow without significant change in cerebrovascular resistance Oxygen consumption by cerebral tissue significantly increased. Nor-epinephrine decidedly increased cerebrovascular resistance and decreased cerebral blood flow despite substantial increase in mean arterial blood pressure Cerebral oxygen consumption was not significantly altered

These findings are clinically significant if vascular beds of other vital organs such as heart, liver and kidneys con

(1) J Clin. Invest. 31:273 279 March 1952.

strict as do vessels of the brain. Nor-epinephrine therapy may sometimes be unsatisfactory or actually harmful. For example, if sympathetically induced vasoconstriction through most of the body was already maximal during an episode of hypotension, nor-epinephrine might increase cerebrovascular resistance out of proportion to the increase in perfusion pressure so that cerebral blood flow might actually decrease.

Effects of Adrenaline, Nor adrenaline and Methedrine® on Renal Circulation during Anesthesia. When hypotension develops during surgery, pressor drugs are often given to restore the systemic blood pressure Two assumptions are sometimes made (1) that low blood pressure is necessarily associated with reduced blood flow to vital organs, and (2) that raising the blood pressure by means of pressor agents will automatically restore the flow toward normal. Both are unwarranted For example, it was shown that when, during anesthesia, blood pressure is deliberately lowered by means of pentamethonium bromide (C5), renal blood flow remains constant and that in normal unanesthetized persons raising the blood pressure by means of adrenaline or nor-adrenaline is associated with pronounced renal vasoconstriction and fall in renal blood flow H C Churchill Davidson, W D Wylie, B E Miles and H. E de Wardener[2] (St. Thomas's Hosp., London) therefore investigated the effects of adrenaline, nor-adrenaline and methedrine® (deoxyephedrine) on the renal circulation during anesthesia

Patients were anesthetized with ether or cyclopropane and kept at a constant anesthetic level. Observations were made on 14 persons during varicose vein ligation or herniorrhaphy In preliminary experiments, these procedures did not themselves affect the renal circulation. Adrenaline and nor adrenaline were given by continuous intravenous drip adrenaline at the rate of 16-38 μg /minute and nor-adrenaline at the rate of 3 5-37 μg /minute Methedrine® was given intravenously in divided doses up to a total of 25-120 mg In 10 persons the effect of the pressor agent was studied after systemic pressure had been lowered by C5

In three patients tested with adrenaline there was an average rise of 11% in mean blood pressure associated with

(2) Lancet 2 803 805 Nov 3 1951.

an average fall of 15% in renal blood flow (range of – to –21%) Average glomerular filtration rate increased by 1%, *and there was therefore an increase in filtration fraction.* In nine patients tested with nor adrenaline there was an average rise of 64% in mean blood pressure associated with an average fall of 18% in renal blood flow (range of –2 to –34%) Average glomerular filtration rate increased by 2% Results showed a wide scatter, but renal blood flow was never increased In six patients tested with methedrine there was an average rise of 64% in mean blood pressure and an average increase of 20% in renal blood flow (range of –9 to +42%) Average glomerular filtration rate increased by 41%, with an increase in filtration fraction. Again the figures showed a wide scatter, blood flow was increased in five patients and decreased in one

The effects of adrenaline and nor adrenaline in anesthetized persons were thus similar to those in unanesthetized subjects. Only methedrine* produced a rise in blood pressure and an over-all increase in renal blood flow though flow decreased slightly in one person In this investigation pressor substances were given both when base line blood *pressure was normal and when it had been reduced by C5* Usually they were given when hypotension was due to shock. No information is available on their effects on the renal circulation in shock, but there is no reason to suppose that the reactions to adrenaline and nor-adrenaline would be more *favorable*

Nor Adrenaline and Methedrine* Comparison of Their Circulatory Actions was made by H C Churchill Davidson and H. J C Swan[3] (St. Thomas's Hosp London) Blood flow through muscle and skin was measured and systemic *arterial* pressure and *heart* rate were *recorded*

Methedrine* was slower acting caused less of a rise in diastolic pressure and was longer acting than nor-adrenaline (Fig 201) Both drugs caused bradycardia Nor adrenaline caused greater vasoconstriction than methedrine *

Nor adrenaline increases blood pressure by constricting peripheral blood vessels and thus increasing vascular resistance It is considered the chemical transmitter of most adrenergic nerves Methedrine* appears to have a more complex action.

(3) Anesthesia 7 4-9 January 1952

In reversible hypotensive states due to decreased vasomotor tone, nor-adrenaline—the physiologic transmitter—restores that defect. Moreover it does not constrict vessels through which circulation has to be maintained, such as the coronary arteries. It controls the level of blood pressure

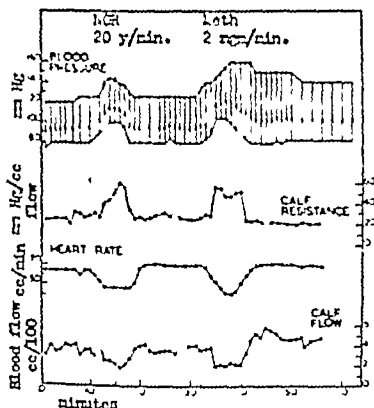


Fig. 201.—Blood pressure, calf resistance, heart rate and calf flow recorded in conscious subject during infusion of nor-adrenaline and methedrine®. (Courtesy of Churchill-Davidson, H. C., and Swan, H. J. C.: Anaesthesia 7:4-9, January, 1952.)

exactly, and, by altering dosage, any desired effect on the pressure may be obtained. However, methedrine® possesses the undeniable advantage that it usually produces the desired effect without demanding the continued attention of the physician.

[The widespread enthusiasm regarding nor-epinephrine may be tempered somewhat by the evidence presented. In addition, there is good reason to reflect seriously upon the indiscriminate use of vasopressors in view of the effects on cerebral and renal circulation in particular.—Ed.]

Anesthetic Problems in Hormonal Disorders of Adrenal Glands were studied by E. M. Papper and George F. Cahill[4] (Columbia Univ.). Patients with Addison's disease are as

(4) J. A. M. A. 148:174-179, Jan. 19, 1952.

grave a risk for anesthesia and operation as any in clinical practice A specific relationship could not be established between precipitation of addisonian crisis and the anesthetic agent or operative procedure Circulatory collapse was the most dangerous and frequent complication observed. It was minimized by proper preparation before operation with adrenal cortex extract in large doses and/or desoxycorticosterone acetate and sodium chloride Hypotension during the anesthetic period was controlled best by administration of aqueous adrenal cortex hormone extract, sodium chloride and whole blood. In administration of the anesthetic it is essential to avoid anoxia, asphyxia or hypotension.

Operative correction of Cushing's syndrome is a serious risk to the patient due to the high incidence of severe post operative shock Preoperative preparation of these patients is similar to that given patients with Addison's disease Preoperative sedation with morphine and scopolamine in doses somewhat smaller than might ordinarily be used is indicated. Clinical experience had not been extensive enough to determine the anesthetic agent of choice, the authors found the nitrous oxide-ether sequence through an endotracheal airway satisfactory Cyclopropane should be avoided because of the frequent need for therapy of a hypotensive state with epinephrine or arterenol. Combinations of the adrenogenital and Cushing's syndrome are possible, and are managed in the light of the more serious complications of Cushing's syndrome

Patients with pheochromocytoma present another problem to the anesthesiologist. The need for adequate relaxation, possibility of accidental pneumothorax, physiologic effects of excessive secretion of epinephrine or nor-epinephrine during manipulation of the tumor and the sudden circulatory depression that may occur after extirpation of the secreting mass are the elements involved in anesthetic management. The authors advise moderate depths of ether anesthesia to obtain adequate relaxation cyclopropane chloroform and ethyl chloride are unwise choices since they are known to produce ventricular arrhythmias in the presence of epinephrine An endotracheal airway should be established to aid in care of pneumothorax should it occur No matter what anesthetic regimen is followed anoxia must be avoided, it is as potent a stimulus to medullary secretion as

manipulation of the tumor If paroxysmal hypertension ensues despite all precautions, piperoxan hydrochloride (20 mg or more) should be given intravenously The severe hypotension and circulatory collapse following excision of the tumor is best controlled by nor-epinephrine given by intravenous drip (4 mg/L), usually at a rate that will maintain moderate hypertension This is an essential therapeutic aid in the first three days of postoperative convalescence

Function of the Anesthesiologist in Management of Patient with Extensive Burns is considered by O R Allen and H C. Slocum[5] (Univ of Texas) in terms of immediate treatment and management during dressing changes and excision of eschars

First consideration is for the patient who is extremely restless at hospitalization One must differentiate among (1) pain (2) apprehension fear and hysteria and (3) cerebral hypoxia as cause for this hyperactivity in determining treatment Morphine is the choice for pain control The maximal dose is 10 mg intravenously larger amounts do not increase analgesia but do increase respiratory depression Intravenous injection of 100-200 mg nembutal® is usually sufficient to allay apprehension and fear Cerebral hypoxia due to circulatory distress requires oxygen and transfusion of whole blood Such patients should not be permitted to drink tap water because of danger of water intoxication Modified Haldane's solution (3 Gm sodium chloride and 1 5 Gm. sodium bicarbonate/L. distilled water) should be given orally in as large amounts as tolerated Cerebral hypoxia due to respiratory distress is treated according to immediate cause An obstructed airway must be cleared or if impossible tracheotomy must be performed Partial obstruction during inspiration will precipitate fulminating pulmonary edema in patients who already have increased capillary permeability During respiratory depression, opiates and barbiturates should be reduced or omitted. Tight pressure bandages around the chest should be loosened For pulmonary edema, oxygen under positive pressure to 6 cm. water should be administered. The head up position may reduce thoracic venous pressure

Maintenance of physiologic balance in extensively burned

(5) Anesthesiology 13 65 70 January 195

patients is difficult. So dependent is this balance on regular and frequent intake of food, electrolytes and water that this routine should not be altered on days when dressings are changed Nitrous oxide analgesia, without premedication, should therefore be employed for dressing changes and débridements, only light premedication with light cyclopropane or nitrous oxide-ether anesthesia should be used for early skin grafts and plastic repairs.

The patient should be mentally prepared for the procedure by being told that he will not sleep but will feel pressure and be aware of movement without feeling pain. It is most important that analgesia be established before pain causing procedures are begun. The patient should breathe a 4-6 L./minute flow of a 4 1 mixture of nitrous oxide-oxygen for three minutes A to-and fro set up with the tail of the bag partly open is best. When analgesia is well established, the patient should be gently lifted from the carriage to the table Necessary dressings and débridements are carried out immediately after which the patient is returned to the stretcher and the analgesia discontinued Throughout analgesia the anesthetist should talk to the patient, varying the nitrous oxide concentration according to the response.

When grafting is necessary analgesia is maintained until dressings have been removed and donor and recipient areas prepared Light surgical anesthesia is then produced by addition of a small flow of cyclopropane As soon as the grafts are cut, cyclopropane is discontinued, and the patient gradually returns to the analgesic state Thus anesthesia is limited to 10-30 minutes for a surgical procedure that may take 1-3 hours. Patients are ordinarily ready for fluids orally on return to bed, only slight physiologic depression is evident.

Effects of High Oxygen Atmospheres on Drug Induced Convulsions were investigated by M deV Cotten and R. P Walton[6] (Med. College of South Carolina) to determine quantitative differences in the effects of drug induced convulsions in high oxygen atmospheres and in ordinary room air In each separate experiment, drug injections were given to 10 animals observed in high oxygen atmosphere and to 10 animals simultaneously observed in ordinary room air

(6) Anesthesiology 12 401-408 July 1951

Using rats and mice 15 experiments were conducted with metrazol,* 12 with strychnine sulfate and 12 with sodium cyanide. Two similar experiments with metrazol* and two with strychnine, contrasting the effects of 15% oxygen atmosphere and of ordinary room air were also conducted.

In contrast to room air, high oxygen atmospheres increased the incidence of convulsions even though they lengthened the span of survival. Survival time, as calculated from over-all average with three drugs, was more than doubled. Survival rates did not differ significantly in the two types of atmospheres. Pulmonary hemorrhage was observed consistently, but was more pronounced in animals maintained in high oxygen atmospheres while convulsion intervals were correspondingly longer. Results in 15% oxygen atmospheres were about the same as those in ordinary room air, with the exception of possibly shorter survival in the former. The hearts of dogs given large doses of strychnine intravenously continued to beat for several minutes during terminal apnea. *Electrocardiogram complexes, when* free of the disturbing effects of skeletal muscle spasm were typical of anoxia and showed no special fibrillary tendencies. Antifibrillatory drugs have no particular value in these conditions.

As far as these implications can be transferred to clinical conditions, the experiments indicate a definite but limited advantage in the administration of oxygen by mask in the intervals between critical recurrent convulsions.

New Tube for Rapid Evacuation of Stomach Contents before Anesthesia in Emergency Procedures is described by *John W. Devine, Jr. and Robert L. Morrison*[7] (Lynchburg, Va.)

Accepted procedure with trauma patients is to evacuate the gastric contents by stomach tube, results are not always successful because suction applied to the tube tends to draw the mucosa into the holes and obstruct drainage. The authors have developed a tube within a tube which prevents this vacuum mucosa obstruction phenomenon by the application of an air vent (Fig. 202). The outer tube is a regular 3 ft. long stomach tube with about 30 holes in the distal 8 in. A small caliber polyethylene tube is inserted to within ½ cm. of the distal end of the outer tube. A

(7) Am. J. Surg. 83 394 397 March, 1952

patients is difficult. So dependent is this balance on regular and frequent intake of food, electrolytes and water that this routine should not be altered on days when dressings are changed. Nitrous oxide analgesia, without premedication, should therefore be employed for dressing changes and débridements, only light premedication with light cyclopropane or nitrous oxide-ether anesthesia should be used for early skin grafts and plastic repairs.

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(6) Anesthesiology 12:491-498 July 1951.

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(7) Am. J. Surg. 83: 396-397, March, 1952.

metal T connector is inserted in the upper end of the outer tube, and the straight limb is closed off by a rubber diaphragm through which a hypodermic needle is inserted to form a tight junction with the polyethylene tube Suction is then applied to the other branch of the T tube so that the outer tube becomes a suction tube and the polyethylene tube provides an air vent of atmospheric air at the distal end. When suction is applied to the small caliber tube an

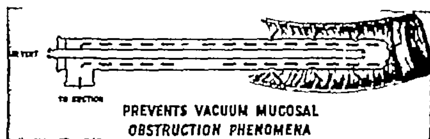


Fig. 202 —Multipurpose air vent gastrointestinal tube. (Courtesy of Devine J W., Jr., and Morrison R. L. Am. J Surg. 83 396-397 March, 1952)

intralumen sump tube results, avoiding a vacuum and giving uninterrupted but slower drainage The point of maximum suction is changed from the uppermost to the distal openings.

This air vent principle is most helpful also in esophageal and gastric resections and in decompressing the small bowel in cases of intestinal obstruction.

Injection Routine in Operating Theaters Present Practice and Suggested Changes. Injection errors are more common than is generally supposed. Many accidents, because they do not end fatally, are not reported W E R Dimond, A. Pollard and A. C Adamson[8] (Greenwich England) conclude from their survey of 45 hospitals that accidents and near-accidents result from the following causes (1) failure to read or check label (2) similarity of ampules containing different drugs, (3) reliance on verbal instruction (4) failure to check premedication, (5) failure to dissolve crystalline drugs completely (6) storage of ampules in colorless disinfectants, whereby contamination of the contents of a cracked ampule escapes notice, (7) inversion of used, rubber-capped bottle in a disinfecting fluid when the negative pressure may draw fluid into the bottle

(8) Lancet 1 410-412, Feb. 23 1952.

(8) use of similar containers for both injectable and non injectable fluids. The authors offer the following suggestions to aid in prevention of injection accidents

1. Ampules containing different drugs should be stored separately
2. Unlabeled containers should be discarded.
3 Containers should be labeled or relabeled only by staff members of the pharmaceutical department
4. Labeling of ampules should be changed so as to make essential information easily legible The print should be larger and should run parallel to the long axis of the ampule.
5 Ampules containing solutions of spinal analgesics should be of a distinctive color, those containing muscle relaxing drugs should be of another distinctive color
6 The surgeon or anesthetist should check all injectable drugs, and orders for such drugs should be in writing
7 A mixing needle or cannula should be used to prepare solutions of such crystalline drugs as thiopentone sodium
8 Preanesthetic medication should be carefully checked before inducing anesthesia.
9 Solutions of morphine or atropine salts and all sedatives and stimulants should be used only from ampules Similarity between multidose containers used for these drugs and those containing solutions of local analgesics is a source of danger
10 Solutions of topical analgesics should be colored.
11 Fluids used for storage of ampules should have a distinctive color so that contamination of contents of a cracked ampule can be seen.
12 Fluids used for sterilization of the skin should have a distinctive color

No ruse or device will replace constant care and vigilance Responsibilities should be clearly defined the administration of the injection is that of the surgeon or anesthetist, and correct preparation of the drug that of the supplier be he pharmacist or manufacturer

Office Practice of Anesthesia. Minor anesthesia does not exist, according to Forrest E Leffingwell[1] (Los Angeles), who stresses that the hazards are increased in the office It is most important, therefore that the anesthetist be

(1) J A. M. A 148 1181 1184 Apr 5 1952.

thoroughly familiar with the action of agents employed, adequately equipped to meet possible complications and effective in the art and mechanics of resuscitation.

Anesthetic should never be given unless oxygen under pressure is accessible A small cylinder of compressed oxygen connected to a well fitting face mask with rebreathing bag attached will satisfactorily inflate the lungs in event of apnea or respiratory depression Suction apparatus, mechanical or water driven, provided with adequate connections and tips, should be instantly available A means to place the patient in the Trendelenburg position quickly should be prepared in advance.

For anesthetic complications, prophylaxis is the best treatment Preoperative status of the patient's circulatory and respiratory systems, and exact time and size of the last meal should be known Normal emptying time for the stomach is 3½-4 hours but if trauma occurs shortly after eating undigested food may remain for 6 10 hours. In case of doubt, a large caliber stomach pump should be used, after checking for loose deciduous teeth or removable dental appliances

Premedication is based on individual needs Few patients require sedatives or narcotics except with local anesthesia If one of the volatile liquids or thiopental is used, adequate doses of atropine or scopolamine should be given beforehand. Intravenous route is most desirable and practical for office use

Most commonly used in the office is thiopental which has little or no analgesic properties, is a powerful respiratory depressant and with which serious laryngospasm is always a threat. It is satisfactory for short procedures requiring no relaxation, in which painful stimuli and other noxious reflexes are minimal. Operations in and around the mouth, nose and throat are not office procedures unless the anesthetist is trained to do an endotracheal intubation and equipment in the office equals that of the average surgery Should laryngospasm develop, curare is indicated

Ether with its wide safety margin is probably wisest choice for office use Vinyl ether and ethyl chloride should be used only for induction preliminary to ether or for procedures that can be completed in that space of time

Regional blocks and local infiltration are particularly

suited for office use Procaine is least toxic, its effect is prolonged by adding epinephrine 1 100,000, its efficiency may be increased by the use of hyaluronidase Concentrations above 1% are unnecessary Stellate ganglion and other blocks of the sympathetic trunk are not office procedures.

Survey of Fires and Explosions in Hospitals of the United States was carried out by Benjamin J Ciliberti and Paul M Wood[9] (Staten Island, N Y), using the questionnaire method There were 2,285 replies from 6,400 questionnaires. From these replies information was obtained on 28 fires and 41 explosions occurring in operating rooms. The com

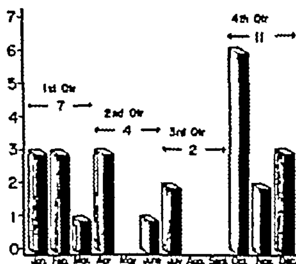


Fig. 303.—Monthly incidence of explosions due to static electricity (Courtesy of Ciliberti, B J., and Wood, P M. Am. J Surg 83 527 530 April, 1952.)

TABLE 1.—Causes of Fires and Explosions

	Fires	Explosions
Static electricity		32
Suction pressure machine	10	
Cautery apparatus	7	2
High pressure	1	4
Breaking circuit (plug pulled from socket)	3	1
Short circuit (broken electrical cord)	2	
Cigarettes	2	
X-ray	1	
Diathermy		1
Mechanical spark		1
Alcohol lamp	1	
Photo-flash bulb	1	

(9) Am. J Surg 83 527-530 April, 1952.

monest source of ignition for these accidents was static electricity (Table 1) Data on the 32 explosions attributed to this cause are given in Table 2 Analysis of the monthly incidence of these explosions (eight not included) showed that the greatest number occurred in the first and fourth quarters of the year (Fig 203) On the basis of their data the authors roughly estimate that about eight explosions a

TABLE 2.—Data on Explosions Attributed to Static Electricity

Case No.	Agents	Month	Relative Humidity	Conductive Flooring	Grounding	Circumstances at Time of Explosion
1	Cyclopropane-oxygen	December	42%	No	None	Static spark occurring during excitement stage
2	Ether-oxygen	October		No	None	Spark when mask removed from face
3	Ether-oxygen	July	High	Yes	Complete	Undetermined source of spark
4	Nitrous oxide-oxygen	April		No	Partial	Static spark at mask
6	Cyclopropane-oxygen	November		No	Complete	Spark when mask was removed
7	Ether-oxygen		High		None	Spark from mask to face
8	Cyclopropane-oxygen			No	Complete	Person made direct contact to mask
19	Cyclopropane-ether-oxygen	November		No		Patient sent to operating room with woolen blanket; mask removed and placed on table followed by explosion
20	Cyclopropane-oxygen	October		No	Partial	Woolen trousers on anesthetist; non-conductive linoleum floor machine being flushed with oxygen
	Ether-oxygen	December			None	Rubber-soled shoes on anesthetist
22	Ethylene-ether-oxygen	Spring		No	None	Explosion followed pushing of anesthesia machine
23	Cyclopropane-oxygen	June	50%	Yes	Complete	Undetermined source of spark
25	Cyclopropane-oxygen	October	75%	Yes	Partial	Sponge rubber cushion on anesthetist stool
27	Nitrous, oxygen, ether cyclopropane		55%	No	None	Circumstances not given but attributed to static spark
29	Cyclopropane-oxygen	Fall		No	None	Explosion followed manipulation of to and fro canister
30	Cyclopropane-oxygen	February	35%	No	None	Breathing bag with small leak touched by anesthetist
36	Cyclopropane-ether-oxygen	January		No	None	Patient in apnea and anesthetist reached for bag having small leak
37	Cyclopropane-nitrous-ether-oxygen	February	50%	No	None	Anesthetist left stool and returned to head of patient; explosion followed
38	Cyclopropane-ether-oxygen	October	54%	No	None	Explosion while changing Y connector
40	Cyclopropane-ether-oxygen	July	85%	No		Nurse anesthetist wore rubber-soled shoes, rubber gloves, silk slip
4	Cyclopropane-oxygen	January	(Low)	Yes	Partial	Data not given but attributed to static spark
43	Ether-cyclopropane-oxygen	October				Spark near breathing bag
46	Cyclopropane-oxygen			No	None	Anesthetist stood up and touched absorber chamber
47	Ethylene-oxygen	December		No	None	Mask removed from patient face
49	Ether-oxygen			No		Anesthetist walked between operating table and machine; explosion followed
53	Not stated	October		No		Face mask hanging near floor contacted furniture causing explosion
6	Nitrous-ether-oxygen	March		No	None	Breathing bag removed from machine and upon replacing explosion occurred
62	Cyclopropane-oxygen	April	69%	No	None	Patient and anesthesia machine being pushed from anesthesia room to operating room
64	Ether and oxygen	February		Yes	Partial	Circumstances not given but static spark said to be cause
66	Ethylene-oxygen			No	Yes	Explosion followed pushing anesthesia machine aside at end of surgery
67	Not stated	January		No	None	Spark from woolen blanket
68	Cyclopropane-oxygen	April		No	None	Circumstances not given but static spark said to be cause

year due to static electricity occur in hospitals in the United States.

Absence of conductive flooring, grounding and proper clothing is responsible for the continued high incidence of explosions due to static electricity

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